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STATISTICS OF RAILROAD TRANSPORTATION

Statystyka Transportu Kolejowego [Statistics of Railroad Transportation], 1954, Warsaw, Pages 3-278

Doctor Wlodzimierz Patlikowski

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STATISTICS OF RAILROAD TRANSPORTATION

CHAPTER I. GENERAL INFORMATION

A. The System of Records and Statistics in Railroad Transportation

1. Significance of the System of Records and Statistics in a Planned Railroad Economy

Railroad transportation which is distinguished by its mass usage, speed, and inexpensiveness of deliveries has played the most important role in the transportation system of Poland for the past century and continues to do so currently. In order to illustrate the weight attached to railroad transportation, it is sufficient to indicate that of the total number of runs made by all types of internal transportation used by the public, railroads still service 95% of the freight loads and over 90% of the passengers.

A considerable part of Poland's national wealth has been invested in the dense network of separate rails, in various types of equipment, and in the rolling stock. The activities of this huge unit with all its materiel technical components, and large body of personnel are directed by a single plan which represents an integral part of the general National Economic Plan.

A planned economy for the railroads cannot be managed without a strong foundation based on a correct system of records and statistics.

The essence of a records and statistics system is represented by the organic unity of the data delivered by the system.

The data for the system of records and statistics are imperative at all stages in the preparation and fulfillment of the plan.

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The drafting of a plan requires accurate knowledge of the point of departure, i.e., the status existing at the moment preceding the planned period. The plan should include data concerning the fulfillment of previous plans and should establish the relationship between planned figures and figures for the preceding period.

Fulfillment of the plan must be constantly controlled and analyzed on the basis of reported data.

The tasks indicated above can only be accomplished through a system of records and statistics once the following more important conditions have been met.

(1) Condition of uniformity, based on a close reciprocal unity among the individual elements of the system and coordination of their data.

(2) Condition of completeness, meaning the incorporation into the system of all organizational branches and units comprising the total railroad economy as well as all pertinent phenomena in this economy; in order to guarantee the designated conditions of uniformity and completeness, the whole system should be centrally created, organized, and directed.

(3) Condition of operativeness, meaning the speed with which data are collected and their pertinentness as well as the application of the content from information that has been delivered for purposes of current administration.

(4) Condition of integrity, necessitating that the data in the system be unconditionally accurate and that they honestly portray a picture of reality.

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(5) Condition of scientific validity, requiring that the methods applied by the system for observation, recording, and analysis of the collected data be based upon scientific foundations in order to preserve complete agreement and unity between practice and theory.

Also the deadlines, form, and content as well as extent of the data delivered by the system of records and statistics should be closely applied to the requirements and goal of the plan.

The factor which organizes this system and supplies it with directives is statistics whose special and primary position is based on the following points.

(a) Statistics plays the role of a tool in the analysis of plan fulfillment.

(b) Statistics uncovers reserves that have not been utilized in the railroad economy and supplies data which make possible the elimination of disproportions in the development of individual economic branches.

(c) Statistics presents a general picture and characteristics for mass phenomena that have been recorded as concrete facts by operational registration and bookkeeping.

(d) Statistics examines the phenomena which have not been encompassed by operational records and bookkeeping.

A socialist planned economy establishes the principle of primacy for the plan in connection with the whole system of records and statistics. Therefore the program, extent, content, form, and

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deadlines of statistical analysis must be completely adjusted to the tasks and requirements of planning. This relationship of unilateral dependency however possesses the criteria of a certain codependence because any progress in the field of statistics also contributes to the development and increased efficiency of planning.

It appears from the foregoing.

(a) that in order to evaluate the degree to which a plan has been fulfilled, it is especially important that the planned quantities and appropriate performance data, which are included in statistics, should be comparable and established by the same method and with the use of the same nomenclature, etc;

(b) that for these reasons it is impossible to compare statistically the data from many months or years, if these data have been established by varying methods and if they apply to objects with differing structures or for other reasons are not appropriate for comparison;

(c) that all intended changes in the methodology of planning and statistics should be first accurately deliberated and mutually agreed upon in order to counteract the indicated divergencies.

2. Records

The term "records" is to be understood as the recording of concrete and individual facts pertinent to railroad activities. Recording takes place usually simultaneously with the notation of facts or is synonymous with filling out primary documents such as commissions, orders, letters of attendance, reports on trips, schedules, etc. Recording is therefore a function of production processes and is conducted primarily for the requirements in connection with directing and administering these processes.

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Regardless of the variety of objects and forms, recording in railroad transportation is conducted in an organized manner on the basis of established questionnaires as well as uniform regulations and orders.

Records exist in each branch of the national economy, but their significance is exceptional in railroad transportation. The necessity for recording a tremendous amount of data every day in connection with the transportation of freight and passengers; information on the number, condition, and location of rolling stock which is in continuous movement; data related to employment, materials economy, etc requires that railroad transportation utilize a highly developed records system.

In railroad transportation, as in any other branch of the national economy, three separate divisions (directions) can be differentiated in recording; there are operational, bookkeeping and statistical records.

Operational, bookkeeping, and statistical records basically pertain to the same objects but from different points of view. This makes itself felt in the manner of handling data, in terminology used for recording, etc.

Operational records are conditioned by the requirements of current work; they represent a direct expression of the latter and usually also an integral part. The significance of operational records in railroad transportation is enormous. A large part of all recording activities is undertaken not only for registration purposes but represents a designated operational activity in itself. As an example one should mention the preparation of fiscal papers,

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transit documents, storage forms, income and expenditure assignations, etc. Therefore the main framework of recording work in railroad transportation represents the operational type for which the operational employees are directly responsible.

Bookkeeping records register the movement of material and monetary values, portray the results of activity and the condition of property in the form of accounting the results and balance, and define the cost of production for the administrative unit. Directed on the basis of general principles, bookkeeping conducts its notations in chronological order of registration and within a system established by the plan of accounts binding upon the economic unit.

The socialist planned economy conforms the work of bookkeeping to its needs and, in connection with the specific function of money in the system of socialism, designates other defined tasks for accounting which tasks are dictated by the requirements of planning.

Bookkeeping has delegated to itself primarily

(1) the basic role in the accepted method for directing socialist enterprises, founded on the so-called economic cost-accounting system;

(2) control over expenditure of social values in materials and money to insure compliance with regulations;

(3) presenting the condition of permanent investments in capital goods and the movement of turnover media as well as the sources for financing both categories.

Statistical records are needed when there is a lack of data in operational recording which pertain to phenomena comprising the

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object under investigation or when there appears to be a necessity for checking or completing the information from operational records. Statistical records are designed to fulfill the requirements of planning and financing as well as for purposes of research. They are characterized by systematicity and the treatment of registered objects as mass phenomena in order to describe them more thoroughly.

3. Reporting

The concept of reporting is to be understood to include all types of documents, reports, schedules, statements, or other similar elaborations submitted to higher administrative units in order to inform them about facts as such.

The functions of reporting are limited in this manner to the presentation of data originating in records, usually in an organized form, based on an appropriate grouping of data as well as the adding up of figures, etc. Reporting does not therefore appear as a separate element in the system of records and statistics but represents itself as being a continuation of recording. The importance of reporting in railroad transportation nevertheless is enormous.

The organization of railroad transportation -- highly complex in its territorial and functional aspects -- creates a situation where reporting presents itself with a great wealth of types and forms.

Similarly to the divisions accepted in recording, transportation differentiates among operational, bookkeeping, and statistical reporting. This should not be understood however as meaning that for instance data from operational records are transmitted exclusively in operational reporting.

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Operational reporting is designated for purposes of administering and controlling the fulfillment of plans, especially operational plans; certain forms of this type of reporting at the same time serve as statistical material.

The dispersal of the production process in the transportation industry over a wide area as well as the need for close cooperation among units far away from one another and the basic railroad branches requires that the railroad, in contrast to the remaining industrial branches, demands a decisively greater centralization of administrative functions and therefore must be based upon frequent and dated operational reporting.

Efficient administration of railroad transportation would be impossible without operational reporting. Administrative efficiency depends to a large degree upon the quality of the reporting.

Operational reporting, using mostly the telegraph and telephone, should be limited to a minimum necessary for operational administration. Excessive development here is inadvisable and often harmful. It is also necessary to remember that the dating of operational reporting permits the application of certain simplifications and even slight inaccuracies are understandable in these conditions. Therefore data from operational reporting must often be controlled by making comparisons with data from statistical reporting. When deadlines are not required, it is wise to eliminate operational reporting in favor of statistical reporting which provides a greater degree of accuracy.

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It is necessary to add that certain forms of operational reporting, which encompass longer periods of time, are represented according to definite patterns and include figures that have been checked; in railroad transportation this is called final reporting.

Reporting of the bookkeeping variety is applied in areas that belong to the tasks and functions of accounting as a separate kind of reporting that has been uniformly standardized by the central authorities. This is also known as financial reporting.

Statistical reporting is used because of the requirements of planning, control over fulfillment of plans, and financing. It includes longer periods of time (at least monthly periods) and is accurate and exhaustive. In contrast to operational reporting, it contains figures established by means of statistical research. These figures in statistical reporting therefore are completely appropriate for a more thorough analysis.

4. Statistics

Statistics is a socioeconomic science. It investigates conditions and developmental processes of a socioeconomic nature as well as their types and forms, with the results of such research expressed in figures assembled in the appropriate manner and processed on the basis of a universal analysis of the socioeconomic conditions (definition of statistics accepted by the theoretical statistics program for USSR statistical schools according to the proposal of Sobol; see Statistische Praxis, No 8, 1953, Berlin, NRD [Niemiecka Republika Demokratyczna -- German Democratic Republic], page 125).

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Statistics therefore is a separate science with its own defined subject matter and an individual methodology. Other sciences also use statistical methods.

It is necessary to add that the word "statistics" usually designates a collection of numerical data describing and characterizing various aspects of socioeconomic life as well as the methodology of theoretical principles, rules, and techniques for a numerical presentation of mass phenomena and processes which has been elaborated and compiled in a scientific way on the basis of statistical practice (see T. Kozlov, Voprosy Ekonomiki, No 4, 1952, Moscow).

The mass character of phenomena, with which statistics is connected, is the reason why in all of its elaborations it utilizes numbers even when the description of a material being investigated is one of quality.

Railroad statistics should be defined as research involving the use of statistical methods concerning the grouping of railroad equipment and functions in connection with the transfer of freight and passengers over long distances.

The specificity of statistical methods is based primarily upon the fact

(a) that common characteristic qualities (described numerically) can be established through systematic groupings of units in statistical material according to prescribed points of view;

(b) that existing connections and relationships can be uncovered by means of an appropriate grouping and comparison in the material under investigation (numerical analysis).

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The organization of mass research is based upon observational statistics, i.e., on the establishment and recording of facts which would serve as a basis for attaining statistical data. Observation is thus the first stage in statistical work.

Railroad statistics is concerned with phenomena which undergo very frequent changes in time. Depending upon the type of phenomena being investigated as well as the requirements of research, the confirmation and registration of facts may take place in two ways:

(a) by observing the state of affairs at a designated moment of time (so-called static observation);

(b) by systematically recording changes transpiring during successive intervals of time (so-called dynamic observation).

In railroad statistics the method of statistical observation is applied during the taking of inventory of capital goods, at the time the first general condition of freight cars is numerically established, etc. According to the principles of dynamic observation current transport is registered as well as the work done by rolling stock and the turnover of materials in storage, etc.

Furthermore, the following are differentiated:

(a) complete investigations, including all objects within the limits of the collection being investigated and

(b) investigations in part, where only a fraction of the objects is submitted to scrutiny.

Partial investigation as a rule is less expensive than one that is complete and it may be conducted much more rapidly. This method is utilized especially when the investigation is connected

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with a loss or damage to the investigated objects; or else when the investigation of the whole collection and obtaining a result free from error would represent a highly expensive, difficult, or even impossible matter.

One of the methods of investigation in part is that called representative investigation, based upon the checking of a certain number of units that are component parts of a given collection but which have been so selected that each unit possesses an identical possibility of entering the "representation"; that is to say that in the selection process one must maintain the principle of equal possibilities. Under such conditions the results obtained from a representative investigation may be generalized and extended to the whole collection. The probability of making an error becomes smaller as the size of the representation in relation to the collection being investigated increases.

Partial investigation -- specifically, the representation type -- is applied very frequently in railroad statistics. Examples are the investigations conducted to check the number of passengers in designated trains and various statistics concerning freight, etc.

Those areas in a given railroad enterprise which have not been encompassed by the program of statistical investigation in force, may be the object of special investigations.

The units under scrutiny, entering into the composition of collected materials for statistics, are grouped systematically according to selected criteria. The results of the compilations of numerical data in each group are collected in statistical tables.

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The correct grouping of investigated units is a basic and difficult problem because the compiled statistical tables should not limit themselves merely to a numerical description and characterization of the collection being investigated but must serve as an objective tool for a scientific comprehension of mass phenomena.

In connection with the quantitative and qualitative framework for mass phenomena, statistics will establish on the basis of generalized groupings also derivative numerical characteristics such as median sizes, relative numbers, and whole factors which it enters in tables; it thus describes the phenomena under scrutiny in their fundamental characteristics and in their reciprocal relations and development.

B. Tasks, Specific Properties, and Subject Matter in Railroad Statistics

1. Tasks of Railroad Statistics

The special position which is occupied by statistics in the system of records maintained by railroad transportation under socialism designates at the same time its main tasks. The remaining objectives result from the general requirements of the whole national economy. In connection with the foregoing, railroad statistics should primarily

(a) represent a tool for the establishment of a starting point during the planning period as well as for control and analysis over fulfillment of the plan;

(b) universally describe the condition and activity of railroad transport, define its structure, reciprocal relationships, and lines of development;

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(c) serve the development and increase the efficiency of railroad economy by means of uncovering nonutilized reserves and irrational production processes by indicating the possibilities of lowering own costs, increasing labor productivity, etc;

(d) throw light on the problem of how to exploit the use of railroad transportation most effectively within the framework of a unified transportation system throughout the whole country.

The most important are indubitably the tasks defined in the foregoing under point (a), related to the requirements of planning. It is therefore indicated that we discuss in greater detail these tasks and the role of railroad statistics in successive planning stages.

The complete planning cycle is comprised of these phases:

(1) drawing up plans and their acceptance;

(2) delivering the plans to the direct executors;

(3) fulfillment and control over fulfillment of plans;

(4) analysis of plan fulfillment.

Only the stage indicated in the second point, i.e., delivering the plans to the direct executors, has no connection with the system of reporting; in the remaining phases this relationship is very close.

Drawing up and Accepting Plans. The basis and an imperative condition for the appropriate elaboration of a plan is the perception of the initial condition, i.e., the situation existing in a given enterprise (establishment) at the beginning of the period covered by planning.

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The plan must therefore include data on the status or targets achieved by railroad enterprises during the preceding period, the goals for the planned period, and the relationship between these goals and the appropriate quantities at beginning of the planning period or the results of the previous stage. It is obvious that data on these conditions or results achieved can only be contributed by a reporting system, which proves that the importance of reports and statistics in this first phase of planning is considerable.

On the other hand the role of statistics in the establishment of figures designating targets for the planned period is limited.

In particular it is not permissible to find the essence of planning in the ability to compile figures (quantities) that have been planned on the basis of statistical data by means of so-called extrapolation, i.e., through the use of a mechanical extension into the future of progress and reciprocal relationships which have taken place in the past. The principles of a planned economy, the forward drive characterizing a socialist economy, and the rapid transformations connected with these dynamics exclude this type of activity.

This concerns of course all plans for railroad transportation, beginning with the planning of freight which represents the initial point and the main economic basis for the remaining plans.

Socialist planning, which means government management of social processes of production, distribution, exchange, and consumption, allows us to base plans for freight transportation on elements obtained from production plans and transport turnover. The accepted method for this purpose is quite complicated; however it does provide accurate and true results which the planning of freight should use

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exclusively. In this connection it is forbidden to operate with various types of simplifications, also based upon extrapolations, as for example the computation of a planned freight load using as a basis transportation to date and the National Economic Plan's accepted average percentage for increased production in the individual branches of the economy. This is impossible, since the National Economic Plan indicates the increase in the value of production and not its mass, this latter aspect being of essential significance in the planning of transportation.

An acquaintance with statistical data plays a still larger role in the planning of passenger transportation. Factors influencing the quantity, directions, and structure of passenger loads are of even greater variety. The remaining branches of the national economy are unable to contribute exhaustive data concerning the transportation of passengers, as a result of which the railroads, in planning this field, are compelled to utilize direct, comparative, and statistical data.

In the remaining fields of planning (plans for labor, rolling stock, capital repairs, investments, employment, supply, costs, etc), statistics cannot serve as a basis for planning quantities but may play the part of an auxiliary and control mechanism.

Control over Plan Fulfillment. The circumstance that statistical data cannot serve as an exclusive or even a principal basis for the drawing up of plans, may lead to another also radical and incorrect conclusion which endows statistics with a passive character of merely observing quantities connected with the realization of the plan. It should not be forgotten that the essential content of planning consists not only of establishing planned figures but also of struggling for the fulfillment of plans.

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The instrument used in this struggle for the fulfillment and overfulfillment of plans is the process of control whose duties are

(1) watchfulness, so that the planned quantities will not only be achieved but even overfulfilled (in a positive sense);

(2) alerting the appropriate agencies in cases where fulfillment of the plan is threatened in any manner;

(3) uncovering, in the course of plan fulfillment, further reserves which may serve as a basis for plan overfulfillment;

(4) announcing instances where the correction of individual operational plans becomes imperative in order to eliminate obstructions in the work of an enterprise.

Without a pervasive system of records and statistics, organized in an appropriate manner by means of statistics, such a type of control over the fulfillment of the plan would be impossible.

Reporting and especially statistics also permit us to establish whether the recipients of services have correctly utilized material means of transportation by removing uneconomic transports (such as those that are useless, cancel one another out, covering too great distances, cutting across one another incorrectly, etc); whether they have contributed to a planned equalization of inequalities in loads; and whether they have used the type of transportation most appropriate for the implementation of given loads.

Analysis of Plan Fulfillment. An analysis of plan fulfillment is conducted on different levels in the organizations of railroad enterprises and in various phases of plan implementation.

The purpose of the analysis is among others the establishment of the reasons why plan fulfillment deviates unfavorably from

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the figures (quantities) that have been planned either quantitatively or qualitatively, as well as the ascertainment of appropriate remedial means which must be applied.

It is unnecessary to prove that the analysis of plan fulfillment is possible only on the basis of accurately reported figures, compiled in the correct manner which corresponds to the needs of the analysis.

Appropriate reporting figures are to be understood as those figures which can be compared with planned figures, i.e., arrived at by the same method and related to the same subject and structure, etc.

It should be noted that the currently applied arrangement of tables in railroad statistics does not always correspond to the needs of a more thorough analysis. One notices especially often the lack of appropriate divisions by ranks and group means.

Of considerable importance is the analysis of numerical characteristics whose purpose is the establishment of factors contributing to the quality of results in railroad transportation. We shall continue to examine methods for analyzing certain of the more important numerical characteristics. There are many of these techniques and their usage depends primarily upon whether the analyzed quantity represents the sum of defined components or whether it is dependent upon so-called factors in a functional way.

2. Special Properties of Railroad Statistics

Railroad statistics are often designated as a "branch" because this refers to a definite part of the national economy. Branch statistics possess many common features in connection with

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the mass investigations and their organization as well as methods for elaborating the collected material. Specifically, it operates basically with complete statistical data. In railroad statistics however we can also see those specific and distinct characteristics which have contributed to a separation of railroad transportation into a branch of its own in the national economy.

The more important differences are the following.

a. In railroad transportation it is impossible to isolate the results of transit production from the transit process itself which is manifested in all stages of the technological transit-production process and which finds its expression in the statistics of transportation. The latter must utilize not only the number of passengers transported and the transit mass in tons but also the appropriate runs expressed in complex measures.

b. In other branches of the national economy the production process is basically localized, whereas in transportation the production process concerns each concrete load and takes place over a large area of space and basically runs along a linear scheme. Therefore the statistics of railroads frequently apply the concepts of districts, sections, lines, sectors, etc for a grouping and the elaboration of statistical data according to a territorial cross-section. This finds itself expressed in statistical tables in which the geographic ranks play an incomparably larger role than in other branch statistics.

c. Railroad transportation utilizes as direct tools of its production especially numerous units of rolling stock which are in constant movement. This makes it necessary to introduce into

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records and statistics on the work of the rolling stock large quantities of appropriate measuring devices and coefficients which would create extensive but compact systems.

d. Utilization of the labor factor in transportation is endowed with a special character. This manifests itself in the employment statistics in which it was necessary to introduce special factors for labor efficiency for the individual services and professional groups.

e. As far as observational and statistical methods are concerned, railroad statistics attempts to limit itself to the essential minimum of registering facts exclusively for statistical purposes and utilizes primarily as source material the data from the strongly expanded operational reporting.

The processing of statistical materials in railroad statistics is based on the general theory of statistics. Railroad statistics however maintains in this connection certain specific properties which can be seen above all in the construction of certain measuring devices applied in periodic statistical research. The above specific characteristics may be condensed as follows.

Types of Measurements in Railroad Statistics. A measurement is a unit accepted for the description of

(1) the condition existing during a designated moment or a period of time;

(2) a quantity for achieved results or an amount of fulfilled work in a given period of time.

Railroad statistics utilize measurements that are simple, complex, or mean.

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Simple measurements include units of time, scale, weight, or even designated activities (e. g., dispatching or transit of a single passenger or of an individual shipment).

Complex measures are units of a type such as passenger-kilometer, ton-kilometer, train-kilometer, axle-kilometer, wagon-day, train-hour.

Mean measures include certain average quantities such as the average load of one freight car in tons or the average number of passengers per axle or the average gross weight of a train, etc. The foregoing measures define mainly the qualitative aspects of mass phenomena.

Methods Applied in Periodic Statistical Investigation. In current practice railroad statistics generally utilizes in its work simple statistical-mathematical techniques. This is shown

(1) in the constant use of general means derived directly from overall totals; these general means, derived without the benefit of separate figures and not having all the component group means, may very easily lead to erroneous conclusions; there arises the need for a frequent analysis of such general mean measurements as well as for a closer concretization of certain mass phenomena by separate complementary research;

(2) in the application of only certain types of derivative characteristics of numbers; these typical and constantly used numerical characteristics include:

(a) among average quantities only the arithmetic mean in its simple or weighted form,

(b) among relative numbers:

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structural factors,

dynamic factors (indexes with a permanent base and chain indexes),

factors of tension, especially in the form of coefficients,

group factors (aggregate indexes).

The foregoing measures and the relative numerical characteristics create an extensive and logically connected system which has taken on varying formulations in the individual branches of railroad statistics.

3. Subject Matter in Railroad Statistics

As far as areas are concerned, it is possible to differentiate the following branches in railroad statistics: (1) the statistics of transporting freight and passengers; (2) the statistics of quantity, repairs, and work of the rolling stock; (3) the statistics of employment (employment, wages, efficient utilization of working time, work discipline, organizational forms and labor productivity); (4) statistics on the technical equipment of transportation; (5) statistics of materiel (supply, materials turnover, consumption of materials and fuel); (6) statistics of finance; (7) abstract-analytical work (methods for compiling abstract statistical tables and techniques for abstracting the analyses in the field of railroad activity.

The matter of so-called exploitation statistics is debatable. Certain authors include here only the statistics of quantity, repairs, and the work of rolling stock; on the other hand there are others who include in exploitation statistics also statistics concerning technical equipment, employment statistics, and materiel statistics.

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Some authors also question the concept of financial statistics and consider that fiscal matters are an object for separate reports as well as balance sheets and therefore do not belong with statistics.

According to I. Kochetov (Statystyka Kolejowa [Railroad Statistics], 1948, Moscow) the functions of financial statistics differ basically from accounting although both disciplines deal with the same subject, i.e., with incomes and expenditures. Bookkeeping approaches the topic of accounting from the point of view of agreement with rules concerning the expenditure of state fiscal means and is also interested in the origin and adjustment of claims by individual persons and enterprises. Statistics on the other hand considers income and expenditure as being the fundamental data for an evaluation and analysis of the financial plan's fulfillment, of the profits in the plan, and of own costs of production; this analysis serves simultaneously for the designation of the degree of dependence of fiscal results from the various aspects of railroad activity.

The requirements of financial statistics have found their expression in the organization of accounting itself. Thus one of the principal tasks of separately conducting so-called analytical bookkeeping is the delivery of analytical numerical data for the purposes of financial statistics.

The above areas of railroad statistics may be divided into three groups:

(1) the first group includes branches in which methods and techniques are applied that are not found in the statistics of other branches of the national economy besides transportation; this group is entrusted with determining statistics of quantity, repairs,

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and the work of rolling stock as well as the technical statistics of railroad equipment;

(2) the second group comprises those branches which have common methodological sectors together with similar branches of economic statistics; the statistics of transporting people and freight as well as financial statistics belong here;

(3) the third group encompasses those branches which are similar in the subject being investigated and in applied methods or are identical with the corresponding branches in other fields of the national economy; employment statistics and materiel statistics should be counted in this group.

CHAPTER II. STATISTICS OF TRANSPORTATION

Subject, Tasks, Area, and Division of Transportation Statistics

The basic activity of railroad transportation, similar to that of the remaining types of transportation, is the movement of freight and passengers. The external results of this activity, i.e., the production of railroad transportation, are the completed transit of freight and passengers. The statistics of transportation is thus the branch of railroad statistics which is occupied with the investigation of completed transit production from the viewpoint of quantity, structure, quality, and development trends.

The numerical data included in the statistical tables for shipments have special significance for the railroad administration. These data are concerned with transportation production and therefore represent the principal basis for a characterization and evaluation of the whole picture in railroad shipments as well as the transportation activity in the individual territorial units.

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The national economy is also very much interested in statistics of shipments, especially in the branch which discusses the transportation of freight. This branch includes numerical data concerning the turnover in goods and therefore throws light on and characterizes in a spatial sense many important problems which are connected with the processes of exchange and distribution and which result from the location of productive forces throughout the country on the one hand and places for further manufacturing or consumption on the other.

This many-sided interest in numerical statistics of loads is proven by the following compilation of important matters in which it is expected that transit statistics will supply rapid and correct numerical information.

(1) For purposes of control and analysis in connection with the plan fulfillment of shipments, transit statistics should describe in sufficient detail transportation production from the viewpoint of

(a) the quantity and structure of shipments as well as the directions of loads;

(b) the quality of transit implementation; statistical figures should reproduce in an accurate manner the degree to which transportation media of railroads have been utilized as well as the uneven and uneconomical movement of shipment processes which require countermeasures by railroad administration with the cooperation of interested branches of the national economy and control organs;

(c) development trends of shipments.

(2) Numerical information about transportation is imperative for the requirements of technical exploitation which would make possible the establishment of the quantity and types of necessary

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transit media as well as the flow of freight and passengers resulting from transportation connections.

(3) For tariff and fiscal needs, transportation statistics should contribute sufficient information in order to conduct analytical work concerning the relationships which exist between the quantity and structure of shipments on the one hand and the income side of railroads on the other.

(4) Also from transportation statistics come numerical data necessary for designating the general efficiency of labor as well as the unit costs of one's own shipments.

(5) For purposes of the national economy, transportation statistics should contribute information in figures needed for a compilation of transit balance sheets, the structure of loads, etc.

All of the foregoing points have one source in common and this is the basic duty of railroads to fulfill the state plan for transportation.

The fundamental tasks of transportation statistics are also derived from this statement and can be designated as follows:

(1) accurate description of completed transit production in order to control the fulfillment of the transportation plan;

(2) improvement of the analysis concerning the implementation of transportation plans for the purpose of discovering insufficiencies and uncovering internal reserves which still exist in railroad transit.

It is understandable that, when requirements and tasks are so extensively considered, transportation statistics is forced to provide numerical data on loads in tons and cars as well as to group figures in tables with various cross-sections -- though all of this in a most economical manner.

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The task of describing accurately fulfilled transit production simultaneously designates the area of transportation statistics. This field comprises

(1) the quantity of loads;

(2) the grouping (structure) of shipments;

(3) the quality of transit implementation;

(4) the flow of freight and passengers;

(5) development trends of transportation.

Transit of freight and the transportation of passengers has much in common. In both cases we are dealing with the concept of dispatching, with a starting and destination point (station) for the loads, transit distance, etc. Even the measurements in both categories of transportation as well as the construction of derivative numerical characteristics are related.

Apart from the shared characteristics that have been mentioned, there are also large differences. For each of the two types of transit in the foregoing a different kind of transportation rolling stock is necessary as well as different equipment, a different type of organization to control movement, and even in part separate service personnel. Also planning in each type of transit utilizes differing methods. In the area of statistics this discussed peculiarity manifests itself in varying characteristics concerning numbers as well as in differing methods for obtaining statistical source material.

Due to the above reasons the transportation of loads as well as the transit of passengers will be discussed in two separate subheads concerning the statistics of transportation.

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The shipment of baggage, express parcels, periodicals, and other similar loads which are large in number but not in weight will require separate mention. In view of the fact that these packages are sent via passenger rolling stock, statistical source material is collected by a method similar to that applied in statistics of passenger transit. The shipment of these consignments will therefore be discussed in connection with the statistics of passenger transportation.

Subchapter I.

Statistics of Freight Transportation

A. Quantity of Transportation

1. Measurements

In order to define the size of loads, statistics utilizes two types of measurements. One of these -- simple measurements -- consists of units expressing the quantity of loads; the other -- complex measurements -- consists of units indicating the number of completed runs. In the following we will discuss these two categories of measurements separately.

a. Quantity of Loads. In accordance with the binding legal norms in transportation as well as the tariff regulations, a consignment is part of a load dispatched for transit on one manifest; the size of the load comprising such a part (consignment) may differ of course and a consignment of long objects can even take up several cars.

The statistics of transportation has relatively little to do with consignments of the above type. The discussion of such shipments comes up when the matter is connected with the organization

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of loads (e. g., rapidity with which consignments are delivered, the organization of statistical research, etc). Whenever the most important aspect of railroad transportation is emphasized -- i.e., mass -- statisticians speak of loads.

The number of loads entering transit during a specified period of time on a railroad network (line) under investigation is called the load mass of this network (line).

In order to define the quantity of loads, transportation statistics uses two measurements:

(a) the ton; and (b) the carload.

The application for this purpose of two different measures is explained principally by the requirements of shipment planning.

A component part of rolling stock, as is well known, is represented by freight cars of differing load and capacity. The result is that the number of freight cars can only approximately indicate the quantity of shipments (size of the transit mass). It is of more importance that the transportation plan, regardless of load in tons, also establish the number of cars needed for the loading of certain types of shipments; the number of these cars depends not only on the size of the load in tons but also on the type of shipments as well as the average loading space in the appropriate category of cars.

b. Runs. In the remaining branches of the national economy, the volume of production can be presented in pieces or units of measurement and weight, i.e., in isolation from the technological manufacturing process. In transportation this is different. Data on the quantity of transported loads in tons or in freight cars do

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not in themselves express the effect of transportation work; they say nothing about transit distance and therefore are insufficient for a complete definition of the quantity of transit production.

For this purpose it is necessary to take into consideration the so-called run which is the expression of the shipment process of consignments at a distance (also passengers) and which represents the essence of transportation. Runs in this branch of transit work are described quantitatively with the aid of a complex measure: the ton-kilometer.

The shipment of one ton of a load over a tariff distance of n kilometers amounts to n ton-kilometers. The transit of a definite number of tons in a load over various tariff distances is equal to the sum of ton-kilometers connected with the shipment of individual consignments.

The above runs take into consideration therefore the number of transported loads in tons (net) as well as the shortest tariff distance in kilometers from the dispatching station (initial transit point) to the station of destination (delivery). Such runs are called "tariff" runs and serve to designate the quantities of transit production completed (realized).

According to the legal-transit norms which bind railroads, a shipment is computed on the basis of the shortest tariff distance between the dispatching station and the point of destination. The transit route of a consignment is established by the railroad; this is done specifically by the dispatching station which is directed by the regulations imposed upon it in this matter. Due to these and other causes, the actual route of transit shipments

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is often longer than the shortest tariff direction. Runs, which consider the weight of a load in tons as well as the actual load route in kilometers, are expressed by the measurement "ton-kilometer net"; they belong to the group of exploitation runs which are covered by statistics of rolling stock performance. The ton-kilometer net (exploitation) are not only computed on the basis of statistical material different from that of the ton-kilometer (tariff), but they also represent a different content from the economic point of view. The effect or result of transportation performance is expressed in ton-kilometers net (exploitation) which is the actual production accomplished by the rolling stock, transferring loads along an actual transit route. On the other hand, the external results of railroad transportation activity are presented in ton-kilometers (tariff), i.e., the quantity of disposed (realized) production; in conformity with the content of agreements entered into for transit, implementation is computed on the basis of tariff criteria which take into consideration among other things only the shortest tariff distance and not the actual route of shipment for a consignment. Tariff runs together with rates for binding tariffs thus decide the revenue aspect of railroads.

However the role and significance of tariff runs for railroads do not end here. Tariff runs should also be considered

(1) in plan implementation and analysis of fulfillment;

(2) in own unit costs for transportation;

(3) for a designation of general labor productivity.

Plans for the work of the rolling stock and plans for materiel, equipment, employment, and exploitation expenses should be based on the exploitation runs; the results representing the quantity and

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quality of the work done by railroad rolling stock are also established and analyzed on the basis of exploitation runs.

For certain reasons, which will be discussed, transportation statistics is compelled to utilize very frequently the net ton-kilometer (exploitation); the latter fulfills the role of liaison between transportation statistics and the statistics of rolling stock performance.

It is necessary to mention one more type of run which results from the direction of the designated transit (planned) which has been defined by directional regulations. These are runs with which the railroad would have something to do if all shipments were carried to the point of destination closely along the route designated by the dispatching station in the transit documents, i.e., according to binding directional regulations. These runs currently have taken on considerable importance because on their basis the revenue from transportation of shipments has been divided among the district supervisory agencies since 1 January 1953. The division of income takes place on the basis of accounting reports from the fiscal dispatching offices which indicate the direction of the shipment as defined by directional regulations. The dispatching station on the other hand may not know and notify anybody about the possible changes in direction which occur after the consignment has been dispatched; such types of changes comprise the actual transit route which is often longer than the route designated by the directional regulations.

The three categories of runs presented above are thus based on the acceptance of different route directions for shipments.

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In this connection the tariff direction provides in summation the smallest number of runs and the actual direction the largest. The disparity expressed in percentages between the general quantity of ton-kilometers (tariff) completed on the network of the PKP [Polskie Koleje Panstwowe -- Polish State Railroads] during a given reporting period and the appropriate quantity of net ton-kilometers (exploitation) fluctuates within limits of 5 to 10%. The divergence between the tariff runs and the runs which exclusively consider the transit route designated in directional regulations is somewhat smaller than the preceding (approximately 2%) and this should be called a planned disparity.

2. Determining the Transportation Quantity

a. Transportation Mass. According to the compulsory planning area for PKP transportation, district administrations and exploitation branches separately list in their plans for shipments the quantity of loads from dispatching points (loading of different consignments in tons and the number of cars loaded) and again separately the number of freight cars "accepted from neighboring networks and from abroad." Such a general characterization of the transit mass, used in the whole PKP network as well as in the networks of the individual administrative districts and exploitation branches, has a dual purpose and namely:

(1) to guarantee the necessary control, and the degree to which the approved plan for transportation has been implemented with regard to the quantity of loads "from dispatching points";

(2) to enable the establishment of the general transportation mass included in the network under investigation.

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The transit mass in a designated network (the entire PKP network, a district, a branch) comprises the following characteristic parts with regard to derivation:

(a) the quantity of loads dispatched for transportation at the stations of a given network; whether the dispatched loads have been designated for other stations within the same network or for stations located outside the borders of the network being investigated (also abroad) is of no significance;

(b) the quantity of loads accepted from neighboring networks and from abroad; as far as the purpose of this acceptance is concerned, it is necessary to differentiate among:

(b_1) loads arriving from one of the stations within the network under investigation, or so-called arrival;

(b_2) loads which are to pass en route across the lines of the investigated network.

Later on we shall discuss separately loads from dispatching points, those from arrival points as well as those carried in transit, although the arrival and in transit types basically are incorporated into the group called "from arrival"; such a division makes possible a more detailed discussion of the subject and is connected with the organization of periodic statistical research.

It should be noticed that the transportation mass of the whole PKP network from a given reporting period does not correspond to the appropriate entire transportation mass, computed for all parts of this network (e.g., for all districts or branches), but is considerably smaller. The reason for this is that different categories of elements comprise "arrival" and "transit" when the whole PKP network is being scrutinized and different ones when e.g., the individual districts are surveyed.

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In the category of arrival, one includes with regard to the entire PKP network only the quantity of loads arriving by railroad from abroad; on the other hand in the network of a designated district one includes among arrival, apart from loads approaching from abroad, also shipments arriving from the remaining districts and reaching the station in the investigated district.

The number of loads carried in transit by the whole PKP network includes only the shipments in transit from foreign communications systems; on the other hand the network of a district carries also in transit consignments from internal communications directly, when the loads from the dispatching administration are taken in transit by the network of the investigated district to the destined administration.

The above explained method for defining quantities of transportation mass within the district network is applied appropriately also to the designation of transportation mass in the network of an exploitation branch.

b. Runs. Runs connected with the transportation of loads may be expressed for the entire PKP network either in net ton-kilometers (exploitation) or in ton-kilometers (tariff). In order to establish the quantity of delivered (realized) transportation production, only tariff runs enter into the picture.

The situation changes if the matter deals with the computation of run numbers fulfilled in the network of a district or a branch. In order to define the runs in ton-kilometers (tariff), each consignment being dispatched or arriving from outside the boundaries of the district or branch should have computed separately the

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transportation route which corresponds to the shortest tariff distance as well as share in kilometers of such a transportation tariff route shared by the individual districts or branches. Instances would be found where the participation in tariff runs would fall to an administration through which no actual run for transporting a consignment had taken place or else the quantity in reality differed to a considerable extent from the theoretical share in the tariff run. A tremendous amount of work, connected with the computation of parts in runs of the tariff type, would therefore be deprived of any practical meaning because it is impossible, e.g., to designate the general labor productivity or own unit costs for a district on the basis of runs taking place according to such an artificial and unrealistic scheme.

In this state of affairs the runs of loads implemented in a district or branch network may be expressed without any hesitation only in net ton-kilometers (exploitation). The result is that the transportation mass in a district together with related exploitation runs (net ton-kilometers) defines the participation of the district in the completed and actual transportation production (for exploitation purposes) for the entire PKP network. In order to implement this, the production actually completed (transportation mass + runs in net ton-kilometers) must be expressed in a different manner, namely by means of the transportation mass as well as the tariff runs. Under conditions created by the PKP it is impossible to apply this second form in its entirety to the production of a district but only to the production of the PKP network understood as a whole.

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The foregoing aspects explain among others why the PKP has not to date computed ton-kilometers (tariff) for the district networks.

It is necessary to mention that on USSR railroads transportation charges for shipments are computed similarly to the Polish system, i.e., for the shortest tariff distance; a network arrangement for railroads that differs from that of Poland allows the USSR to transport consignments as a rule along tariff routes; as a result the divergence between exploitation runs and tariff runs is at a minimum there and this allows the transportation production of the "route" (equivalent to Poland's district administration) to be expressed in ton-kilometers (tariff).

Ton-kilometers (tariff) are computed by a centralized method on the basis of transportation documents but only for the entire PKP network. Results from the computations of tariff runs are presented in statistical tables as applicable to the transportation mass (dispatch, arrival, and transit) for a given reporting period. When calculating tariff runs, no attention is paid to the fact that consignments dispatched for transportation, e. g., on the last day of a given month will arrive at their destination the following month. Runs connected with such shipments will therefore only be completed in part or in their entirety during the following month.

Net ton-kilometers (exploitation) are computed on the other hand within the individual district administrations on the basis of work schedules for locomotives; in these documents the individual in charge of a train registers the net ton-kilometers relating to a designated date and marks the train number as well as definite sectors.

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Depending upon the distance and the direction of the transportation, the run of a concrete car shipment may be registered in sequence on a larger number of work schedules for locomotives with different dates.

As a result of this state of affairs, tariff runs computed for the dispatch and transit of shipments take precedence during the registration period over pertinent runs of the exploitation type and vice versa; tariff runs computed for the arrival of these consignments are delayed in time with regard to the corresponding exploitation runs. Thus both tariff and exploitation runs, computed for the entire PKP network during the same 24 hours, basically relate to different consignments which are not comparable. The longer the reporting period, the more these foregoing differences become blurred.

A similar picture also appears in the district or branch networks, although for these networks one does not calculate in tariff ton-kilometers but exclusively in net ton-kilometers. The registration moment for consignments from the dispatching point or in transit takes precedence at stations of these networks over the time of registration for related exploitation runs, whereas the registration of shipments from arrival comes at the time when the process of transferring and recording the pertinent exploitation runs has been completed.

The statistically accepted connection between the transportation mass for a given reporting period with the net ton-kilometers (exploitation) fulfilled during the same reporting period is thus of an agreed upon nature; the results obtained in this manner are in reality more or less an approximation to the accurate results, the arrival at which would require a considerable investment in time and costs.

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3. Characteristics of Transportation Quantity

For the purpose of throwing light on statistical figures pertaining to the size of transportation loads as well as to facilitate a comparative evaluation of results obtained for transportation from the quantitative point of view, the statistics of transportation has introduced a number of appropriate derivative numerical characteristics; they have appropriate application for the characterization of quantities either for the whole collection of transported loads or else for the individual categories and groups in the collection. The following are among the more important characteristics.

(1) The average distance for transporting one t of a load in kilometers. By dividing the sum of runs completed within a certain network by the number of loads in tons corresponding to these runs, one obtains the average transportation (run) distance for one ton of the loads in kilometers.

This is a weighted arithmetic mean, since it is obtained by the following method:

$$l_{av} = \frac{P_1 l_1 + P_2 l_2 + P_3 l_3 + \ldots + P_n l_n}{P_1 + P_2 + P_3 + \ldots P_n} = \frac{\sum Pl}{P},$$

where $P_1, P_2, P_3, \ldots, P_n$ = weight of individual shipments in tons;

$l_1, l_2, l_3, \ldots, l_n$ = distance for transporting individual consignments in kilometers.

There is a close relationship between the three quantities: number of loads, runs, and average distance of a transport in kilometers. If only two of the quantities are known, it is possible with the help of a simple arithmetic equation to compute the third quantity

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$$/ \sum P = \frac{\sum Pl}{l_{av}} \text{ and } \sum Pl = \sum P \cdot l_{av} /.$$

From the composition of statistical tables or from other indications it should be quite clear whether the average transportation distance was obtained from completed ton-kilometers (tariff) or from net ton-kilometers (exploitation).

The general quantity of net ton-kilometers for the entire PKP network is computed by summing up the quantities of net ton-kilometers on the network of all individual district administrations. Since the total summation of the transportation mass from all individual district administrations, as a result of the methodology in computing, is larger than the transportation mass calculated centrally for the whole PKP network, this proves that the average distance for the transportation of one t on the network of the individual districts must be appropriately smaller than the quantity of that average for the whole PKP network, if the following equation is to be filled:

$$\sum Pl = \sum P \cdot l_{av}$$

The situation in the network of the district administrations is similar in relation to the networks subordinate to the exploitation branches.

On the basis of the relationship expressed in the formula

$$\sum P = \frac{\sum P\,l}{l_{av}}$$

the author of this outline was able to work out a method for the computation of the general quantity of the transportation mass (Q, or $\sum P$), which during a given reporting period would apply to

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the network under investigation even if one does not have at his disposal numerical data concerning the dispatch, arrival, and in transit quantities or if the data are insufficient or not trustworthy enough.

The quantity of the transportation mass may be elicited from the quantities obtained from the statistics of work done by rolling stock on the basis of the following formula:

$$Q = \frac{\text{sum of ton-kilometer (exploitation)}}{\text{average run of loaded freight car}} + \text{number of station shipments in tons}$$

In the above formula the denominator "average run of loaded freight car" is the exploitational equivalent of the "average distance for transporting one ton in kilometers" (see statistics on quantitative status and work of rolling stock under the heading "Utilization of the Freight Car in Time"). The transportation of station consignments is not registered by the train supervisor in the work schedules of locomotives; the number of station shipments, quite substantial in certain districts, must therefore be added to the number of loads computed in the first part of the formula.

The average distance for transporting one t, computed for the whole transported mass, is for many purposes a much too general quantity which should be complemented by the establishment of an average distance of transportation for the individual types of freight that enter into a given transported mass.

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TABLE 1

AVERAGE TRANSPORTATION DISTANCE OF ONE TON FOR MAJOR GROUPS

OF LOADS ON NORMAL-GAUGE PKP LINES 1948-1951

No	Load Group	Participation (in %) of transport mass		Average Distance for transporting one ton in kilometers			
		1948	1949	1948	1949	1950*	1951**
1.	Hard coal, coke, dust in general	42.4	39.3	311.0	300.5	278.9	285.1
	thereof:						
	dispatch within the country	-	-	210.3	277.6	225.8	232.9
	Dispatch abroad overland	-	-	280.9	291.9	275.5	277.8
	Dispatch to seaports	-	-	512.9	499.5	490.1	496.9
2.	Agricultural commodities	7.9	5.6	167.0	154.2	196.1	188.0
3.	Stone, sand, gravel	6.8	7.8	138.1	164.7	167.6	173.4
4.	Cement	1.6	1.7	257.2	271.6	279.0	274.9
5.	Ores and pyrites	4.1	3.3	308.4	253.4	237.8	255.8
6.	Petroleum and products	0.9	8.7 [sic]	255.2	244.3	214.1	241.4
7.	Chemical industry products	2.1	2.5	223.0	234.7	218.0	241.5
8.	Wood materials and products	5.3	5.2	234.8	244.5	232.9	283.2
9.	Ceramic, cement, and glass products	2.9	4.0	197.3	249.7	241.9	239.9
10.	Metals, products and blocks	4.6	4.2	190.1	188.3	196.1	197.3
	Total for transported mass			247.0	247.1	235.9	237.8

Notes. * According to data for first 6 months.

** According to data for first 9 months.

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Table 1 presents the changes in the average transportation distance for one t in relation to certain types of freight which comprise a substantial percentage of the total mass transported by normal gauge PKP Railroads during the years 1948, 1949, 1950, 1951.

The data in this table allow us to arrive at these conclusions.

(a) Hard coal, coal dust, and coke represent about 40% of the mass transported by railroads and thus exert a tremendous influence on the formulation of the average transit distance for the total mass carried in railroad transportation.

(b) The average transportation distance for one t of hard coal, coal dust, and coke for consumption inside the country varies during the individual years within the limits of 210 and 233 km; on the other hand for export over land and by sea it varies between 275 and 513 km; in this manner a larger portion of hard coal and coke in export represents a factor that will lengthen considerably the average transportation distance for one ton of PKP freight. Without this export the average transportation distance for all of the remaining transported mass (together with hard coal, coal dust, and coke for consumption within the country) would average around 210 km, i.e., on a level 26 to 37 km lower than that observed in the years 1948-1951.

The economic significance of the average transportation distance for one t of freight, computed for individual categories of products, lies in the fact that the elicited figures represent the average distance from the production site of the given commodities to the site of consumption, further processing, or export. One of the purposes in planning transportation is transit of the

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freight mass with the least possible consumption of materiel transportation media, expressed among others with the help of runs. The way to attain this goal is the elimination of uneconomic transportation, such as counterruns, incorrect crosscutting runs, too long runs, and certain duplications. An external expression, attesting to the effectiveness of efforts undertaken along these lines, will be not only a shortening of the average transportation distance for the individual commodities but also for the total transit mass and thus a decrease in transportation labor, a more rapid turnover in freight cars, etc.

The struggle to shorten the average transportation distance is of tremendous importance to railroads and to the national economy. A positive result in this battle would permit on the one hand the fulfillment of allotted transit with less rolling stock, less fuel, and less labor, etc; on the other hand it would permit a decrease in the expenditures of the national economy which are connected with the commodity turnover.

(2) Factor in transportation efficiency per one kilometer. The value of the transportation efficiency factor per kilometer is computed by dividing the quantity of tons in freight, dispatched for transit along a designated line (network) in a given period of time, by the exploitation distance of the line (network) expressed in kilometers.

A comparison of the value of the factor, evolved for individual years on the basis of the total network in the country and ultimately of the networks in other countries, makes possible the establishment of the relationship between the quantity of freight dispatched for transit at stations of one's own network and factors of an economic, political, geophysical, etc nature.

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On the other hand the value of a factor arrived at for individual sectors, lines, or regions indicates the degree to which the number of freight tons dispatched from the station of a given sector, line, or region remains in relationship to the economic structure of the pertinent gravitation area. It is known that the value of the factor is formulated in a certain way in primarily agricultural regions, in a different way in mixed regions with more agriculture than industry, and in still another way in regions that are predominantly industrial. The enumerated statistical data are of great significance to economic research involved in drafting projects for new railroad lines.

(3) Factor of transportation efficiency per inhabitant. The value of this factor is calculated by dividing the number of freight tons dispatched for transit over the railroads network in a definite region or for the total network in a given period of time by the number of people within the given region or in the whole country.

The value of this factor represents the average quantity of freight in tons, which is dispatched by railroad, per head of population in a given region or in the whole country.

The economic importance of this factor is similar to that of the factor for transportation efficiency per kilometer.

The factors described under (2) and (3) attain greater expression when compiled together with the appropriate factors elicited for the dispatching process in a given area, including all media of public transportation.

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(4) Factor of transportation effort for freight per one kilometer. The value of this factor is computed by dividing the number of ton-kilometers or net ton-kilometers, completed on a designated line (network) during a given period of time, by the length of the exploitation line (network) expressed in kilometers.

The value of this factor, attained for the whole network for a given period of time, is a quantity which per se does not provide a sufficient characterization because similar factor values are achieved with a large transit mass and a small average transportation distance or else with a smaller mass and a large average transit distance. In order to use this factor for comparative purposes, it is advisable to have a knowledge of numerical data concerning the transportation mass and the average transit distance.

The value of the factor, obtained in net ton-kilometers for designated sectors or lines, indicates the degree to which these sectors or lines have been utilized for transportation purposes. It should be mentioned that the value of the factor frequently influences in a decisive manner not only the local dispatching or the arrival of consignments but rather the shipments in transit across a given sector or line; thus the high value of the factor, observable in railroad transportation on so-called major lines or within the networks of certain district administrations of state railroads which are distinguished primarily by the fact that their work is characterized by its "in transit" nature, becomes comprehensible.

(5) Factor of transportation mass for products of a given type. This factor is expressed in percentage of the relationship between the quantity of transportation mass for products of a given type during a specified period of time (usually by year) and the

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general mass of these commodities originating in produce, manufacturing, or imports. The factor defines therefore in percentages that part of the total mass of a given product which, entering into the turnover, becomes an object in transportation. This factor may be computed either for the transportation of a given type of commodity by means of a designated transit medium or for transportation including all transit media. The value of the factor, computed for the latter instance, will be correct only when duplicate or manifold counting of the same consignment, in cases where it has been carried successively by two or more transit media during a single transportation process, has been eliminated.

Certain kinds of commodities require separation, sorting out, and repacking in storage places or even further processing before they reach their final recipient. Such action precipitates multiple transits as a result of which the value of the factor may go above 100%; illustrations are paper and paper products for which the value of the factor in railroad transportation amounts to about 400%.

B. GROUPING OF FREIGHT TRANSPORTATION

Under subheading A we discussed measurements and derivative numerical characteristics which are utilized for a quantitative description and characterization of transit production connected with the relocation of freight. This production was discussed previously in terms of an undifferentiated collective.

Transportation production in reality consists of an extremely complex structure (composition). In order to illustrate this structure, transportation production is submitted to a grouping process on the

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basis of different criteria dictated by requirements of an exploitation, tariff, fiscal, or other nature. The groups obtained in this manner are of course uniform from the viewpoint of the accepted characteristic.

Among a large number of applied groupings, the following should be mentioned as the more important.

1. Grouping by Types of Transportation

The formal point of departure for this grouping is the type of transportation documents that accompany the individual consignments and are decisive as to the legal transit norms or tariff regulations under which the given shipment is carried.

From this point of view we differentiate among the following types of consignments.

(1) Express commercial shipments and ordinary commercial shipments whose transportation is regulated by the decree of 24 December 1952 on the movement of consignments and passengers by railroads; these comprise the most numerous group which includes shipments by all remaining branches of the national economy excluding the railroad agency itself.

(2) Economic consignments and (3) official shipments; regardless of the part played by the carrier, the railroad is frequently itself a dispatcher and recipient of such freight; this is inevitable due to its planned activity. Compensated transit of economic shipments and the uncompensated transportation of official parcels are regulated by separate internal service regulations, approved by the minister of railroads; the quantity of these consignments is relatively large and this explains the necessity for

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their separate treatment in statistics concerning the transportation of freight; the statistics of transportation however do not encompass the transit of materials for road construction which are implemented by so-called work trains; the labor performed by these trains is recorded only in the statistics of rolling stock work.

(4) Military shipments, carried on the basis of separate rules, issued by the Council of Ministers.

(5) Station consignments; here we find shipments by ordinary freight cars, loaded and unloaded within the area of the same station; their transportation takes place on the basis of a completed form in writing, according to rules laid down by a tariff decision.

As can be seen from the foregoing enumeration, the essential criterion for grouping shipments according to category of transit is the relationship of the carried freight to the national economy.

2. Grouping According to Directions of Transportation

Grouping according to directions of communication is a subject for special and manifold interest. In connection with the statistics of transportation, the demand has been formulated for extensive detailing in the grouping process. That is the explanation why the collectives encompassing the three basic groups (foreign communication, internal, and sea ports) are submitted to further groupings in order to separate subgroups in the first and ultimately in the second ranks. This type of grouping is represented currently as follows.

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a. Foreign communication:

(1) dispatched abroad by land with a further breakdown into groups according to countries of destination;

(2) arrival from abroad by land with a grouping on the basis of dispatching countries;

(3) transit by means of the PKP network with a grouping by dispatching countries and the latter by countries of destination;

b. Internal communication:

dispatch within internal communication; separation of an individual subgroup for "arrivals" is indispensable because the dispatch and arrival in internal communication represent for the total PKP network a collective that is fundamentally identical;

c. Communication with seaports:

(1) dispatch with a further grouping according to the nearest ports of destination, i.e., to Gdynia, to Danzig, to Stettin, and to other ports;

(2) arrival with a grouping according to the following ports of dispatch: from Gdynia, from Danzig, from Stettin, and from other ports.

3. Grouping According to Types of Communication

Grouping on the basis of types of communication permits the establishment of the structure for transportation over the total PKP network and along the networks of the individual district administrations from the point of view of the relationship between the district and the completed transit work. This grouping assumes in practice more and more significance; on this type of grouping the PKP has lately based its division of revenue from transportation among the district administrations, at the same time that different principles have been accepted in relation to freight "in local communi-

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cation" and other ones "in direct communication." Sometimes the term "neighborly communication" is used instead of "direct communication," but this is not accurate; it may lead to an erroneous conception, inasmuch as the mentioned group includes the transportation of freight only between stations of two adjacent district administrations.

The grouping of freight transportation according to types of communication differentiates among the following two types of transit.

(1) Local Communication. Here we find transportation of freight in which the dispatch and destination stations as well as the transit route are located within the area of the same district administration; such transportation therefore begins and ends within the boundaries of a district network. Transportation within a local communication circuit represents an autonomous production of a given district and the income from this activity is retained exclusively by the pertinent administration. There are no obstacles basically to prevent us from having the runs connected with such transportation expressed not only in net ton-kilometers (exploitation) but also in ton-kilometers (tariff); practical considerations of course militate against this procedure whereby a part of the runs completed within a district would be described by using two measurements and the remaining part (and this is a larger part which refers to direct communication) only by using one measurement.

(2) Direct Communication. All remaining transportation of freight belongs here; in such instances the dispatching station and the destination are not within the area of the same district administration. In direct communication, the transportation production

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is completed in a manner similar to that of a chain where the individual districts have to fulfill only one of the phases of this production. The administration participating in direct transportation may represent not only the dispatching administration but also the destination administration and the administration in transit. Within the existing composition of the PKP network and with the current administrative division, one concrete transportation operation in direct communication may have as participants at the most five district administrations (an administration for dispatch, one for destination, and three in transit).

Transportation fulfilled in direct communication may not be counted by participating administrations as their own autonomous production; as a result of this also the influence of such runs must be appropriately computed for the purpose of finding out the pertinent revenue for the interested administrations and their districts.

In connection with the uneven distribution of production forces in the country, certain administrations (e.g., Katowice) have a majority of freight from dispatch, whereas other administrations (e.g., Danzig) have the same situation with arrivals, while in others still (e.g., Lodz) the greater part of freight is in transit. Also the reciprocal relationship among runs connected with dispatch, arrival, and those in transit varies for the different administrations, depending not only upon the preponderance attached to dispatch, arrival, or "in transit" but also on the geographic location of the stations with the largest turnover in freight, on the actual direction taken by the larger flow of freight on the PKP network, etc. The knowledge of such numerical data pertaining to these relationships is of great importance to the characterization of the individual districts from the point of view of transportation and exploitation.

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The transportation of each concrete load, regardless of mode of communication, is counted only once for the whole PKP network. It is different within the district administrations; the transportation of freight within local communication circuits will be counted in only one administration; however the transportation of this same concrete load in direct communication will be counted, depending on the particular case, within two, three, four, or even five district administrations.

The described state of affairs results in a situation whereby the reciprocal relationship in percentages between the transit in local communication and the transportation in direct communication differs when we examine the structure for the total PKP network in contrast to the average structure within one district for the same reporting period. This is illustrated in Table 2.

TABLE 2

PARTICIPATION BY PERCENTAGE IN TRANSPORTED MASS ALLOTTED TO THE INDIVIDUAL TYPES OF COMMUNICATION

January 1952

Type of Communication	For the Total PKP Network (in %)	Average in One Administrative District (in %)
Local communication	42.01	21.52
Direct communication		
a. between two adjacent districts (without transit)	29.27	30.00
b. with transit through one district Administration	20.42	31.39
c. with transit through two district Administrations	8.14	16.68
d. with transit through three district Administrations	0.16	0.41
Totals	100.00	100.00

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The above table was worked out on the basis of numerical data included in the compilation for exchange of freight between the individual districts and branches of the PKP for the month of January 1952.

4. Grouping According to Types of Freight

Of special importance in a very large variety of problems is the information gleaned from transportation statistics concerning the type of freight carried. These problems include the following: the appropriate composition in numbers of freight cars, construction of freight tariffs, analysis of revenues, transportation balance sheets according to type of freight, control over the implementation of the freight plan, etc.

Statistical nomenclature for freight carried is patterned after tariff nomenclature. This originates from the fact that statistical material is based on transportation documents and the latter include a designation of the freight according to tariff terminology.

A specific nomenclature for all transported loads encompasses several tens of thousands of definitions. The compilation of statistical charts in so-called categorical commodity statistics, with a maintenance in full of their individualization, would be tedious and excessively costly as well as completely unnecessary for statistical purposes. In these conditions statistics must aim at simplification of tables by grouping all types of loads carried into a relatively small number of categories, i.e., into the framework of so-called classification.

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Such a systematization of designations for shipments carried runs into difficulty insofar as the classification has fundamental significance in the remaining branches of the national economy as well as in railroad work itself, though from different points of view.

The national economy places special emphasis upon:

(1) adding to the individual groups related types of shipments on the basis of economic considerations, e.g., products derived from minerals, agriculture, forestry, individual branches of industry, etc;

(2) the uniformity of nomenclature applied in statistics for different kinds of transportation and its being in conformity as far as possible with the nomenclature utilized in the remaining fields of the national economy.

Classification for railroad requirements has a different significance; in accordance with this it is necessary to differentiate between the exploitation and tariff points of view.

For purposes of exploitation, the classification process should above all inform us about the facts concerning quantity of rolling stock and loading facilities as well as the types needed for the implementation of transit. In this connection classification should be formulated in such a manner that the following commodities will be placed in the same statistical groups:

(a) the units of rolling stock which can be used for transportation of the same type or even of the same load capacity;

(b) items dispatched for transportation in the same month or season of the year.

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Transportation of commodities by rolling stock of the same type requires a varying number of rolling stock units depending upon whether the loading of such commodities takes place during the same month or season of the year or in different ones.

For tariff purposes, on the other hand, classification should be more highly differentiated and the same statistical groups should include types of freight which are

(a) related to one another;

(b) characterized by a similar importance economically;

(c) equal or close in own unit cost of transportation.

At the present time statistics of freight transportation utilizes the two following nomenclatures with reference to the types of freight being carried.

(1) A basic nomenclature, mainly for tariff requirements. It includes over 200 positions within 73 groups for types of freight. Each group and position is designated with the appropriate statistical numbers. For each individual statistical position, one or more tariff positions have been counted.

(2) The nomenclature accepted for operational requirements of planning the transportation of freight. Statistical compilations elaborated according to this nomenclature are supposed to guarantee control in terms of whether or not and to what degree the individual ministries (agencies) have fulfilled the loading plan according to types of freight. This nomenclature may therefore be limited to a small number of designations and at the current time the following 17 categories of groups are enumerated; in these approximately 80% of the total transportation mass on PKP networks takes place:

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(1) hard coal

(2) other coal, coke, coal dust, and briquets

(3) ores and pyrites

(4) all types of rock

(5) sand and gravel

(6) petroleum and its products

(7) metals and metal products

(8) all kinds of brick

(9) cement

(10) artificial fertilizer

(11) other chemical products

(12) grain

(13) potatoes

(14) sugar beets

(15) other produce and agricultural products

(16) wood and wood products

(17) other.

This nomenclature also corresponds to the exploitation needs of railroads.

5. Grouping According to Zones of Distance

The average distance for transporting one t of freight in kilometers is characterized too vaguely for certain requirements, especially for tariffs; it requires therefore supplementary research and a more detailed description. Of considerable importance is the knowledge as to the manner in which the carried mass (total or in designated groups, e.g., types) is divided into so-called zones of distance that represent the equivalent of class divisions in a statistical division series. The boundaries of the individual zones

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of distance in kilometers are established in relationship to the requirements of the conducted investigation. It is necessary to take into consideration in this connection that the acceptance of narrow limits for the individual zones will present a more detailed picture, but it does lengthen excessively the size of the table. Most frequently for the beginning zones one accepts small divisions in kilometers, whereas for the end zones the divisions are appropriately increased.

For computing each zone, the number of tons that falls to each distance zone from the total mass transported is the criterion. Results in grouping the carried mass in individual zones of distance may also be expressed in fractions which designate that part of the total mass being transported that is computed for a given distance zone; fractions obtained in this manner express the so-called relative frequency.

In the attached Table 3, compiled in the above manner for the transportation of certain commodities along normal gauge PKP lines in 1937, it appears that the zones with the largest quantities are quite spread out and that relatively few of them are in the beginning or end parts of the tables. The greatest quantity is manifested by the middle zones whose boundaries in kilometers do not deviate much from the average distance for transporting one t at that time and amounted to approximately 300 km.

This is explained by the fact that the transportation of commodities above all is the result of commodity turnover among the various economic areas and therefore takes place at relatively large distances.

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TABLE 3

TRANSPORTATION OF CERTAIN COMMODITIES ALONG NORMAL-GAUAGE PKP LINES IN THE YEAR 1937

Grouping according to distance zones for transportation; relative frequency expressed in percentage of carried mass pertaining to the type of commodities.

Types of Commodities	Distance Zones in Kilometers												
	1-10	11-20	21-30	31-40	41-50	51-60	61-70	71-80	81-90	91-100	101-150	151-200	201-250
Wheat	0.5	2.2	5.7	5.5	8.4	4.5	5.2	3.7	2.4	2	9.9	4.9	4.1
Rye	1.6	4.8	5.1	3.8	5.6	3.6	3.7	2.9	2.8	2.5	8.6	6.8	6.1
Unprocessed wood from deciduous trees	0.9	4.2	3.9	6.1	5.2	5.1	4.7	3.2	3.5	5.1	13.6	7.7	4.8
Unprocessed wood from conifers	3.5	9.3	9.1	11.3	5.7	5.8	7.6	4.3	4.2	3.9	11.5	7.8	4
All types of regular bricks	2.7	7.9	8.9	6.2	4.9	5.2	2.3	2.5	2.3	2.3	6.7	5.3	10.3

Types of Commodities	Distance Zones in Kilometers											
	251-300	301-350	351-400	401-500	501-600	601-700	701-800	801-900	901-1000	1001-1100	1101-1200	Total
Wheat	3.3	3.8	2.8	4.9	9.5	8.9	4.3	1.4	1.5	0.5	0.1	100
Rye	4.7	3.8	3.6	7.1	9.9	9.8	1.9	0.5	0.4	0.3	0.1	100
Unprocessed wood from deciduous trees	3.5	2.7	2.6	4.3	3.6	3.6	2.6	4.8	2.6	1.6	0.1	100
Unprocessed wood from conifers	1.8	1.7	1.2	1.9	1.6	1.7	0.9	0.8	0.3	0.1	-	100
All types of regular bricks	11.3	9.6	4.5	4	2.1	0.5	0.4	0.1	-	-	-	100

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6. Grouping in Territorial Cross-Section

In railroad transportation the basic unit for the organization of transit is the station. Knowing the interstation communications for transportation, i.e., the quantity and type of freight dispatched at the individual stations as well as what has arrived at these stations, it is possible subsequently to group the transportation of freight into the territorial cross-section desired.

The mentioned interstation transit communications are best pictured through the medium of the so-called correlation (a type of chess board) tables in which the "subject" of the table (or the "from") are the stations dispatching the freight and the "predicate" (or the "to") are the stations for which the freight is destined. Tables are compiled for the individual categories of freight as well as for the total freight. The stations for dispatching and destination are located in the table in geographic order.

In case of a territorial grouping of stations for dispatching as well as arrival within the appropriate district administrations, exploitation branches, provinces, or other regions, the correlation tables will appropriately illustrate the interadministration, interbranch, interprovince, etc exchange of freight.

Correlation tables are quite generally disseminated since they provide a simple and clear picture. This is an example of such a table in which the regions for dispatching and arrival have been numerically designated.

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Dispatch regions / Arrival regions	No 1	No 2	No 3	No 4	No 5	No 6	No 7	Total from dispatch in millions of tons
No 1	4	0	0	1	1	0	1	7
No 2	3	7	2	4	1	1	2	20
No 3	1	1	5	3	1	1	2	14
No 4	9	2	1	10	3	1	7	33
No 5	1	1	1	2	6	1	2	14
No 6	2	0	0	2	1	5	1	11
No 7	1	0	0	2	2	1	4	10
Total from arrival in millions of tons	21	11	9	24	15	10	19	109

The numbers in the individual boxes, cited by line, indicate how many tons of freight have been dispatched from a give region to the various regions of arrival; figures read by columns indicate the tons of freight which have arrived in a given region from the separate dispatching regions. The figure "0" means that between the given regions there was no freight connection or that it did not amount to one million t.

The "total" numbers in the last box of each line should be understood as the sum of dispatches from a given region, whereas the "total" figures at the bottom of each column represent the sum for arrivals in the given region.

An analysis of the foregoing illustrative correlation table permits us to deduce a series of important conclusions and confirmations which are related to the following.

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(1) The degree of concentration for dispatch and arrival of freight according to regions. The degree of mentioned concentration is indicated by this compilation.

From Dispatch			From Arrival		
No of region	in millions of tons	by percent of total amount	No of region	in millions of tons	by percent of total amount
4	33	30.3	4	24	22.0
2	20	18.4	1	21	19.3
3	14	12.8	7	19	17.4
5	14	12.8	5	15	13.8
6	11	10.1	2	11	10.1
7	10	9.2	6	10	9.2
1	7	6.4	3	9	8.2
Totals	109	100.0	Totals	109	100.0

(2) Surpluses of dispatches or arrivals of freight in the individual regions, resulting from the contrast between dispatch and arrival quantities.

No	Region	Dispatch	Arrival	Dispatch Surplus (+)	Arrival Surplus (-)
	1	7	21		14
	2	20	11	9	
	3	14	9	5	
	4	33	24	9	
	5	14	15		1
	6	11	10	1	
	7	10	19		9
	Totals	109	109	24	24

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In regions with a surplus for arrivals (numbers 1, 5, and 7), there arises an excess of empty freight cars which, as a matter of personal disposition, must be transferred to regions with an excess of dispatch. The relationship of the number 24 (surplus of dispatch or of arrival) to the figure 109 (total quantity) represents in this particular instance the value of the so-called irregular coefficient of dispatch and arrival and simultaneously the ratio between numbers of empty cars, necessitating transfer, and the general number of cars used for the transportation of 109 million t of freight.

Resulting from the compilation of dispatch surplus (+) or arrival surplus (-), we arrive at the so-called regional transportation balance sheets concerning which there will be further discussion on the following pages.

(3) The relationship between the quantity of transit in local communication and the general amount of freight carried. In the table the size of the numbers in the boxes is striking with regard to those which are situated along the diagonal of the table; these figures are related to the turnover of freight within the area of the given regions, i.e., to local communication; the total amount of loads carried in all seven regions of local communication in the table amounts to 41 million t and it amounts to 37.6% in relationship to the general quantity of freight from dispatch or arrival (109 million t).

(4) The relationship between the quantity of freight in local communication for the individual regions and the amount of loads carried to a region or taken out of it. In region No 3 for example the total number of loads from dispatch amounts to 14 million t; from this figure one must subtract 5 million t which belong to

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local communication in order to obtain the quantity of freight carried out of the region, namely 9 million t; the sought after ratio thus is $\frac{5}{9} = 55.5\%$; the ratio for arrivals is computed similarly.

Two labor consuming end operations (loading and unloading) are connected with each individual transit in local communication, whereas only one operation is involved in export or import. The last type of relationship that has been discussed allows us therefore to ellicit a further derivative characterization concerning the relationship between the quantity of labor in loading for local communication and the amount of the same labor for export and import.

On the basis of correlation tables, compiled according to designated regions however, it is impossible to obtain information regarding the number of loads transferred through the region in transit. The geographic distribution of regions is an obstacle here because it does not correspond to the scheme of lines.

If a correlation table were to be drawn up only for a designated line or sector and the stations were to be located on the table in a geographic order, then it would be possible to establish for each direction of movement separately:

(a) the number of loads in transit through an optional point on the line (sector);

(b) the number of runs completed between two optional points.

Table which describe the formulation of freight transportation along a designated sector apply especially for the establishment of a load flow, concerning which there will be more said in subsection D.

In order to picture the transportation connections between the branches and the district administrations, the PKP utilizes a

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correlation table with a fragment illustrated in the appended Table 4. The tables are compiled separately for each of the 17 category groups of freight which have been discussed previously. The construction of a table is quite complicated, since it includes boxes of two types: larger ones designated by thicker lines for the district administrations and, inside of these, smaller boxes for the appropriate exploitation branches. Such a construction of a table facilitates greatly the analytical work and especially the uncovering of uneconomical shipments.

In close connection with the grouping of dispatch and arrival in freight along a territorial cross-section are the so-called transportation balance sheets. The dispatch and arrival of shipments is the transportation expression of product exchange which takes place between the individual economic regions of the country (industrial, agricultural, forestry) or among the administrative regions (province, district administration of state railroads, exploitation branch, etc). The above mentioned exchange is based upon the export of products which are manufactured (extracted) in a given region at a surplus rate in relationship to its own needs, with the simultaneous import of deficit products to this region.

An analytical compilation which has as its task the establishment as to whether a given region, on the basis of an exchange of loads, manifests during the reporting period a surplus of imports or a surplus of exports in relationship to a designated type of shipment is the transportation balance sheet.

The transportation balance sheet is computed as the algebraic difference (balance) between the quantity dispatched for a defined type of shipment on a given region and the amount from arrival of

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the same load category within a reporting period (most frequently within a year). If dispatch is in the majority (i.e., export), the transportation balance is described as positive and the dispatch surplus is designated with a plus sign. When arrival (i.e., import) is in the majority then the balance is negative and the arrival surplus is marked by a minus sign. When dispatch and arrival are equal or if there is a complete deficiency for both export and import, then the balance is listed as zero.

In compilations establishing a transportation balance, it is necessary to take into consideration the export and import by all media of transportation individually which may come into play for this particular set of circumstances.

In the organization of periodic statistical investigation, the elaboration of a separate type of statistical compilation has been foreseen. This is the so-called "dispatch according to provinces" (see Subchapter I, subhead "I. Statistical Compilations and Reporting," point 7, "Dispatch according to Provinces") which serves the Main Statistical Office primarily for the working out of transportation balances according to dispatch and arrival for provinces.

An example of a tabular form in the calculation of the transportation balance is the elaboration according to the following formula (Table 5).

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Types of Transportation	Dispatch in 1,000 t			Arrival in 1,000 t			Transportation balance
	Total	Transit inside region	Export col 1 - col 2	Total	Transit inside region	Import col 4 - col 5	col 3 - col 6
	1	2	3	4	5	6	7
1							
2							
3							
Totals	4850	2000	2850	5650	2000	3650	-800

On the basis of similar formulas which have appropriately changed content formulation, plans are elaborated for transportation balances. These represent an initial point of departure for the correct planning of the shipment of freight for purposes of railroad consumers.

Transportation balances are also of interest above all to the remaining branches of the national economy. The described balances serve them as an aid for the planning of distribution of commodities, for the planning of industrial localization, etc.

Transportation balances however have considerable significance also for transit itself and especially for the economic justification for the construction of new railroad lines and roads or the rebuilding (expansion, improvement) of already existing lines of communication.

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TABLE 4

Name of commodity .....

Compilation of exchange between branches and administrations for month (year)

Statistical Number	RMO* and DOKP** destination / RMO and DOKP dispatch	Load in tons into car	DOKP Warsaw			DOKP Lublin		DOKP Krakow			DOKP Stalinogrod						DOKP Lodz					etc
			RMO Warsaw West Station	RMO Warsaw Praga Station	RMO Siedlce	RMO Lublin	RMO Kielce	RMO Krakow	RMO Rzeszow	RMO Nowy Sacz	RMO Stalinogrod	RMO Gliwice	RMO Opole	RMO Rybnik	RMO Tarnowskie Gory	RMO Bielsko	RMO Sosnowiec	RMO Lodz Kaliska	RMO Czestochowa	RMO Ostrow Wielkopolski		etc
11	RMO* Warsaw West Station																					
12	RMO Warsaw Praga Station																					
13	RMO Siedlce																					
1	DOKP Warsaw																					
21	RMO Lublin																					
22	RMO Kielce																					
2	DOKP Lublin																					
31	RMO Krakow																					
32	RMO Rzeszow																					
33	RMO Nowy Sacz																					
3	DOKP Krakow																					
41	RMO Stalinogrod																					
42	RMO Gliwice																					
43	RMO Opole																					
44	RMO Rybnik																					
45	RMO Tarnowskie Gory																					
46	RMO Bielsko																					
47	RMO Sosnowiec																					
4	DOKP Stalinogrod, etc																					

Notes. *RMO [Ruchowo-Mechaniczny Oddzial -- Traffic-Engineering Branch]

**DOKP [Dyrekcja Okregowa Kolei Panstwowych -- District Administration of State Railroads]

xRMO Exploitation Branch

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7. Other Types of Grouping

Among the large number of other possibilities for types of groupings, it is necessary to mention the two following actually applied to the PKP.

(1) The grouping of consignments of loose small goods and car shipments. A small package is one whose real weight does not amount to more than 5,000 km or, when transporting livestock, does not occupy less than 10 sq m of the car floor space; heavier shipments or those occupying a larger area of the car floor than the foregoing are considered to be car shipments.

(2) Grouping according to agencies (ministries) to whom the dispatchers of consignments are subordinate. Such a grouping has considerable significance when it comes to checking whether and how the individual agencies implemented the loading plan according to types of shipments.

C. Analysis of Quality in Transportation Production

Among the attributes characterizing the quality of production in transportation, there are also included the kind which in other branches of the national economy describe not so much the quality of the finished production as the technology of implementation. This results from the fact that in transportation it is impossible to separate the production from the technological process of manufacturing; transportation production is the very process of relocating freight.

Due to the above reasons, we have to deal with a superficially unique phenomenon in transportation. It involves this:

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the higher the quality of production in shipping goods, the larger the quantity in which it can be implemented with available technical and material means.

In order to guarantee the highest quality to transportation production, a decree in 1952 on the shipment of consignments and passengers by railroads requires both the railroads and the customers to organize planned transit with the smallest utilization and consumption of transportation media.

Among the more important criteria concerning the quality of transportation production are the following:

(1) exploitation of loading capacity in freight car

(2) uniformity in shipments as to time

(3) uniformity of transportation regarding directions

(4) economic aspects of shipments

(5) speed in delivery of consignments

(6) delivery of shipments in one piece and without essential damage to their substance.

Only the average weight of the load in tons, characterizing the exploitation of freight car capacity, is a quantity directly planned.

The quality of transportation production is expressed also in the transportation plans through an exclusively indirect manner, as for example in the following cases.

The degree of uniformity in transportation during a period of time is presented through transportation plans by appropriate distribution into quarters and months for the shipment either of the entire collective loads or of designated types in the load groupings.

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The degree of uniformity in transportation for directions is illustrated by the appropriate compilations of load flows.

The degree to which shipments are economical is expressed in transportation plans by the scope of the elimination of uneconomical shipments, concerning which we will have more to say later on, etc.

The point of departure for a qualitative analysis of transportation production are thus the appropriate statistical figures from the implementation of transit which relate to the size of transportation, distribution of shipments in time and direction, numerical data in correlation tables, average distance for transporting one t of a load, decreasing value of the factor for mass of shipped products in a designated category, and other similar quantities.

Later on we shall discuss the methods for conducting analyses, which are applied to the criteria of quality in transportation production.

1. Exploitation of Freight Car Capacity

A quantity which characterizes the degree to which the capacity of a freight car has been exploited is the average load weight in tons which falls on one freight car or on one axle of a freight car.

The individual freight cars differ considerably as to loading capacity; an external expression of this is among other things the varying number of axles on cars. The loading capacity of cars however is not in direct proportion to the number of axles; at any rate the difference between the permitted weight load per axle of different cars is smaller than the difference between the loading capacity of these same cars. It is therefore important to derive the average load weight per car axle rather than per car.

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The described numerical characterization takes on two forms: statistical and dynamic. The statistics of transportation is occupied with a static form of this characterization; the dynamic form will be discussed in connection with the statistics of rolling stock labor.

"The average weight load in tons" (q_s) from the static point of view is a regular arithmetic mean, the quantity of which is derived according to the following formula:

$$q_s = \frac{\sum p}{n} \quad \text{or} \quad q_s = \frac{\sum p}{ns}$$

where p is expressed in tons for the load weight of individual cars, loaded at stations of a given network or accepted in a loaded state from beyond the boundaries of the network;

n is the number of loaded cars and the number accepted in a loaded condition;

ns is the number of axles on loaded cars and the number accepted in a loaded state.

While computing the average load weight in tons for a designated station, there enter into the calculation only the loaded cars at the given station, i.e., loaded cars in arriving trains are not taken into consideration.

The formula indicates that the average quantity refers to the condition of the cars at the moment of their dispatch, i.e., a condition which is as if it were still static.

From the above formula it can be deduced that

$$n = \frac{\sum p}{q_s} .$$

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On the basis of a second formula, the planned quantity of loads in tons is computed into the number of cars necessary for loading.

In the statistics of transportation, one presents the quantity of the average load in tons for the total mass being transported as well as for the individual types of loads; not all types of shipments permit the exploitation in full of freight car capacity which finds its expression also in the binding load norms.

As the statistical numbers indicate, the resulting quantity of the discussed mean increases in the PKP with the passing years. Two factors precipitate this result: (1) improvement in the exploitation of freight car capacity because of efforts made by customers and the railroads; (2) introduction into the rolling stock of units (cars) with an ever increasing loading capacity. Systematic investigations are being conducted in order to establish the degree to which each one of these factors has contributed to the improvement of results.

2. Uniformity of Transportation in Time

The efficiency of railroad transportation depends in a large degree upon the uniform and rhythmic development of transportation work. There are however various causes which unfavorably influence the uniform flow of transportation. Certain of these causes act in a periodic manner; as a result of this we encounter periodic transit volume fluctuations having the length of a cycle that is dependent upon the type of cause; other causes manifest themselves and function irregularly.

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Among the causal factors which function in a periodic manner are the following:

(1) the periodic climatic cycle which lasts a year and gives rise to seasonal fluctuations not only in the transit volume but also in the types of shipments carried;

(2) the very undesirable phenomenon showing itself en masse in industry and commerce and relating to the so-called "speed-up" in the monthly plans; this causes a distinct rise in transportation during the third 10-day period of each month;

(3) the decreased loading of cars on Sundays, lowering the amount of transportation labor during the first days of each week.

Among the reasons effecting the size of transportation in an irregular manner, we can also count these: unfavorable atmospheric conditions, transportation assignments over and above the plan, etc.

Changes in the distribution of transportation, which are the result of these various causes, often have a cumulative effect and create either so-called transportation peaks or breakdowns; the one and the other precipitate difficulties for railroad transportation.

A description and an explanation of the discussed changes, which in sum total comprise the lack of uniformity of transportation in time, is of basic significance in railroad transportation.

The degree to which there is this lack of uniformity in transits expresses itself by means of a factor for the irregularity in loading or by the factor of irregularity in runs.

The above factors express a relationship which takes place between the quantity of load or the number of runs in a given month and the average monthly quantity within one year.

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The derivation of factors for the irregularity of loads may occur only when data concerning the annual size of completed loading or the annual number of runs are known, which in turn enables us to compute the monthly average. During the year it is possible to designate the value of the mentioned factors only in orientation figures, compiling the loads or the runs that have been completed in a given month and comparing them with the average monthly plan for loading or runs.

The railroads are especially interested in the formation of the value for the factor in the monthly peaks of concentration for transportation. This arises from the fact that in order to master this problem during peak periods, the railroads must have at their disposal appropriate reserves in line utilization, rolling stock, personnel, etc. The degree to which transportation during a peak period may deviate from the monthly average for a given year is illustrated, for example, by the value of the factor for irregularity which has been deduced in connection with the shipment of freight on normal gauge PKP railroads during the peak months in the fall (October and November). This value during the postwar period up to 1949 was maintained for the total mass shipped on the PKP network within limits of approximately 1.22 to 1.25; for commercial consignments alone it was between 1.16 and 1.28.

Due to this phenomenon of irregularity for shipments in time, one cannot take the position of passivity based on the application of material media, employment, etc to a changeable and irregular quantity of transportation. On the contrary, by means of appropriate planning of shipments, especially from the side of the consumers

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of railroad transportation, it is necessary to strive energetically toward an equalization of shipments over the whole year. It is obvious that the result of such an action will not be the complete elimination of irregularity in shipments. On the other hand the degree of concentration in transportation should be formulated in a planned manner with application to the development and requirements of the economic life in Poland as well as to the conditions for a rational exploitation of transportation media.

Analysis of Seasonal Fluctuations. Seasonal fluctuations in the intensity of shipments are connected in Poland mainly with the periodic cycle of the climate during the annual period.

The size of seasonal fluctuations is designated usually by the computation of average deviations in monthly values over a period of many years from the general average during the total period under investigation. For this purpose, on the basis of monthly data over several years, regular arithmetic means are computed for the individual months: January, February, etc; deviations are also established from the general monthly average during the whole period of observation. Deviations may also be presented in percentages of the general monthly mean.

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Example

SHIPMENT OF COMMERCIAL CONSIGNMENTS ON REGULAR GAUGE PKP LINES FROM 1947 TO 1950

Dispatch in millions of tons for individual months (see note)

Year	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
1947	4.6	3.5	4.6	5.2	6.3	6.3	7.0	6.6	7.1	7.2	8.1	7.6
1948	6.6	6.3	7.4	7.8	7.0	7.9	8.4	8.7	9.1	10.3	10.4	8.5
1949	7.5	7.1	9.0	9.7	9.7	10.0	10.5	10.8	11.2	13.0	13.0	11.1
1950	9.4	9.7	12.2	10.9	11.4	11.6	11.6	12.3	12.2	13.9	15.1	11.7
Totals	28.1	26.6	33.2	33.6	34.4	35.8	37.5	38.4	39.6	44.4	46.6	38.9
Averages	7.0	6.6	8.3	8.4	8.6	8.9	9.4	9.6	9.9	11.1	11.6	9.7
Deviations	-2.1	-2.5	-0.8	-0.7	-0.5	-0.2	+0.3	+0.5	+0.8	+2.0	+2.5	+0.6
Deviations in %	-23.1	-27.5	-8.8	-7.7	-5.5	-2.2	+3.3	+5.5	+8.8	+2.2	+27.5	+6.6

General monthly mean over a 4-year period amounts to 9.1 million t

Note. *According to Wiadomosci Statystyczne [Statistical News] published by GUS [Glowny Urzad Statystyczny -- Main Statistical Office].

The arithmetic means obtained in the above manner for individual months over a period of many years represent typical values on condition that the concentration of shipments during a period under investigation does not manifest a directional movement over several years which would definitely increase or decrease itself. The computed averages for deviation express a concentration of seasonal variations

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which are characteristics for the phenomenon under observation. The average deviations given, expressed in the form of percentages for the general monthly average, may serve as an aid for the requirements of planning the shipment of freight.

3. Uniformity of Shipments in Directions

Under subhead "D" entitled "Flow of Shipments" a topic is discussed which manifests itself in the form of a universally unequal quantity for two flows of freight that are proceeding along the same sector (line) in different directions. The uneven volume of the two flows may pertain to all of the freight or to shipments of a designated type. This phenomenon, also defined as irregularity of transportation in directions, negatively influences the work of railroads and causes as a result the unproductive run of empty rolling stock units from regions with a surplus of arrivals to regions with a surplus of dispatch, increase of own costs for transportation, etc.

The degree of irregularity of shipments with respect to directions is designated by the factor of irregularity for directional freight that is empty and that is loaded; this factor represents the relationship between the amount of load in tons transported during the reporting period in an empty direction and the number of tons carried during the same period of time in a loaded direction. The value of the factor is usually less than one.

The phenomenon of irregularity of shipments as to directions is primarily the result of an uneven distribution of production forces within the country and the connected processes of relocation for manufactured products. It is impossible to eliminate completely

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the discussed irregularity, but the degree of irregularity should be formulated in a planned manner with the idea of maintaining the value of the mentioned factor on a level possibly close to one under given conditions.

4. Rationality of Shipments

Uneconomical are those shipments which cause unnecessary or too long shipment runs or runs which complicate the work of exploitation, even though there is no simultaneous increase in the run of shipments.

Uneconomical transportation includes specifically:

(1) counterrunning shipments, open or concealed; open and counterrunning shipments are those which carry the same type of loads as shipments in opposite directions along the same sector of a route; concealed and counterrunning shipments are those in which transportation occurs in opposite directions involving the use of different sectors (lines) of a network;

(2) shipments connected with an incorrect confluence or intersection of flows for the same loads, entailing a run that is too long; as an illustration we may mention the shipment of the same steel products from Skarzysko Kamienne through Koluszki to Lodz as well as from Stalinogrod through Koluszki to Warsaw, instead of from Skarzysko Kamienne directly to Warsaw and from Stalinogrod to Lodz;

(3) too distant shipments completed from a faraway source of products, regardless of the fact that the destination can be supplied with the very same products from sources located closer;

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(4) railroad transportation not implemented by routed trains, although possibilities for this exist;

(5) shipments for which an inappropriate medium of transportation has been selected, although the possibility existed for using a more applicable medium; examples are the shipment of commodities that are completed over short distances by railroad and not by truck;

(6) duplication of shipments, when the same commodity is transported twice or several times as a result of poor organization of distribution, improper location of storage space, etc.

Analysis indicates that the number of unnecessary runs connected with uneconomic runs comprises a very serious percentage of the total number of runs. It is sufficient to cite as an example the losses incurred during open counterrun shipments; from the appropriate computations (the reader will find more details in the book by Pariskaja, Tolstoi, and Mots, entitled Planirovanije towarnych pierewozok [Planning of Freight Shipments], 1947, Moscow) it appears that when two identical loads of different weight are dispatched, the unnecessary run amounts to 2 pl, where

p, number of tons in the load with the smaller weight;

l, length of the sector along which both shipments actually proceeded in opposite directions.

How large the complications in exploitation work are as a result of uneconomical transportation may be seen from the following example. When a consignment is shipped by freight car over a distance under 30 km, the time necessary for the turnover of the car amounts to from 2 to 3 days and nights. On the other hand when shipping over a distance of 250 km the turnover time for the freight car increases only twice. This can be explained by the labor-

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absorbing functions connected with the dispatch and arrival of the shipment; these functions are independent of the distance shipped. It is necessary to add that one truck using an average number of work hours can relieve in one 24-hour period from seven to eight freight cars utilized for transportation over short distances.

The elimination of uneconomic shipments decreases expenses to the national economy paid for the shipment of freight. For railroads on the other hand this is equal in results to the liberation of considerable transportation reserves. A solution to this problem depends upon the planning of transportation appropriately by the consumers as well as counteraction by the railroads which should have the cooperation of the remaining branches of the national economy and of the state supervisory organs.

The tasks of transportation statistics include however the elaboration of statistical compilations in a form which would enable the exposing of uneconomical shipments. Correlation tables above all belong to such elaborations.

5. Speed of Delivery of Consignment; Delivery of Shipments in One Piece and Without Damage to Substance

All branches of the national economy daily entrust to railroads the transportation of freight with a total value of many hundreds of millions of zlotys. Rapid delivery of consignments as well as delivery to the recipients in one piece and without damage to the substance clearly attest to the quality of transportation production on railroads. Such efficiency is primarily to the advantage of the railroad which bears material responsibility for the delivery of shipments within designated time limits as well as

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in a more acute degree for the substance of consignments carried. The national economy also must place special emphasis upon the fact that turnover media in the form of railroad shipments should have the shortest possible period for runs because of the huge collective value and also because freight represent social property and therefore should not be damaged or suffer loss during the course of the transportation process.

The faster railroads will transport and deliver shipments, the smaller will be the general number of loads which are constantly on the road; this applies also to their general value in total. Let us say for instance that the PKP network loads an average of 0.48 million t in freight per 24 hours, i.e., 20,000 t per hour. If we further assume that the delivery of one consignment takes an average of 120 hours (5 days and nights) and that the value of one t of freight amounts to approximately 1,500 zlotys, we arrive at a total value for all shipments which are en route on railroad cars:

20,000 x 120 x 1,500 = 3.6 billion zlotys.

Under such conditions an increase in the speed of delivery of consignments by an average of only one hour would give the national economy a saving of 30 million zlotys in turnover media of freight cars that are on the road. This saving is in reality only a single operation and, in case of a successive postponing of the deadline for delivery of shipments for an average of one hour, it is lost.

The speed of delivery for shipments has not been up to now an object for periodic or special statistical investigation by PKP. As appears in the pertinent literature published by the Soviets, such a type of statistical investigation has been conducted many times on USSR railroads. On the other hand damages paid to the

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customers in connection with violation of deadlines for delivery as well as damages for loss of shipments or parts thereof as well as for damages to the substance of consignments are a matter of separate periodic reporting by the PKP.

D. Flows of Shipments

We call the total shipments carried in a given time along a designated route for transportation in one direction of movement a flow; its volume is defined by the number of consignments (in tons or in freight cars) transferred during the same time through the individual points of the transportation route.

The quantity of the flow and its composition changes along the transportation route; at the intermediate stations certain shipments leave the flow while others are added.

There are several methods to present statistically and graphically the flow of shipments. The most often applied statistical method is the following.

The content of the flow, which is a collective of various parts, is first submitted to a grouping according to type of loads carried. Depending upon the purpose for the investigation, the flow may undergo a further supplementary grouping from the viewpoint of transportation category, direction, or type of communication, etc.

In the next stage the flow content, uniform as to type of load, is submitted to a grouping according to territorial cross-section. For this purpose, the actual transportation route (railroad line) is divided into interjunction station sectors and each

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sector has drawn up for it a correlation table with which we are already acquainted. Playing the role of subject and predicate for the table are the sector stations in a strict geographic order. Such a table describes as a rule two flows in opposite directions along the same sector; the flows are separated in the table by a diagonal with unfilled boxes; the unfilled boxes arise due to the fact that the stations as a matter of principle do not dispatch shipments to themselves.

The table enables us to deduce

(a) the volume of the flow at each station along the transit route;

(b) the quantity of ton-kilometers completed between the individual stations;

(c) and to establish the loaded direction and the empty direction for a given category of freight (flow with a larger number of shipments indicates the loaded direction; flow with a smaller quantity of consignments an empty direction).

Information which may be gleaned from a table in the described format is for many purposes completely satisfactory.

It is necessary to watch however that the table encompass the following four different categories of shipments:

(a) consignments that have their origin and destination within the boundaries of the sector;

(b) shipments starting from a loading point at a station in a given sector and extending beyond the borders of the sector;

(c) loads originating in other sectors but destined for unloading in a given sector;

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(d) freight carried in transit through a given sector.

It is only in reference to shipments indicated above under (a) that the described table will provide a relationship, i.e., the dispatching station as well as the destination station. As far as the categories of consignments indicated under (b), (c), and (d) are concerned, the information from sector tables are from this aspect incomplete and do not suffice for such purposes, e.g., as the routing of trains, the establishment of loads for individual sectors in directional planning of transportation, etc. If the sector tables are to present a connected picture of the transportation routes for all shipments, they must have a somewhat changed composition.

TABLE 6

From station \ To station	A	Transit beyond point A	a	b	c	d	e	f	B	Transit beyond point B	Total sent
A											
Transit to A											
a											
b											
c											
d											
e											
f											
B											
Transit to B											
Total arrived											

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Either in this same table or in a separate appendix, it is necessary that the numerical data pertaining to transit be regrouped according to relationship; it is purposeless in this connection to provide station reports since it is sufficient to indicate relationships according to sectors and at times even according to dispatching branches or else destinations.

Tables supplemented thus permit us to observe the process of shipment streams through successively following sectors. A stream of consignments are those shipments which possess the same place of origin (or dispatching stations) as well as places of disappearance (or destination stations) and also a common transportation route.

The usual graphic manner for presenting the flow of freight takes on the form of one or more lines (stripes) on a schematic map and these lines are placed on both sides of the transportation route. The width of the stripes corresponds, in accordance with an accepted scale, to the volume of the freight flow, whereas the color of the lines designates the type of freight carried. Similarly one also designates the flow of empty units of rolling stock. The location of the stripe in relation to the transportation route agrees with the binding direction of the movement (right-handed movement).

The periodically elaborated numerical and graphic flows of freight and empty units of rolling stock are extremely useful for exploitation purposes on railroads, which makes possible or facilitates the

(1) determination of degree to which a given sector is being used for transportation work;

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(2) establishment of shipments and quantities being carried along a given sector; loaded direction and empty direction for these consignments;

(3) picturing the origins and end points (sectors) for the individual composition parts of the transportation flow (of so-called load streams);

(4) systematic conduct of a labor analysis for transportation along the individual sectors;

(5) routing of trains.

The compilations illustrating flows of freight also possess a considerable importance

(1) in directional planning of consignment transportation;

(2) in elimination of uneconomic transfer of shipments as well as empty freight cars;

(3) in economic settlement of accounts and

(4) in designation of required railroad investments (reconstruction of overloaded lines and junction station or building new ones).

E. Trends of Development of Freight Shipments

1. Movement Trends over the Years

In countries with a socialist economic system, which is characterized among other things by a planned economy and broadened socialist reproduction, the total quantity of industrial and agricultural production and in this connection also the size of transportation, increases systematically from year to year and manifests therefore a one-directional movement with a development trend that is continuously increasing over many years. In countries with a capitalistic

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economic system on the other hand the appropriate movements over many years have a changeable tendency in their development which is dependent upon the economic condition of the market.

Dynamic series, worked out according to months and representing the development of transportation during a period of many years, illustrate not only the annual changes in the concentration of these phenomena but also the seasonal variations. Several methods exist which differentiate within the dynamic series and produce an individual sharp picture of movements over many years; among these methods for transportation phenomena, the most appropriate are the graphic method and the method of the average variable.

In the case of the graphic method the values pertaining to the size of the load and to the number of completed runs during a period of several years are transferred to a chart. Next the annual and seasonal variations are evened out in order to obtain a straight line or a straightened out crooked line with a definite direction of movement. The described method is not sufficiently objective and the inscribed directional lines may miss the variations having essential significance.

The method of the average variable is based on the computation of arithmetic means from successive series, encompassing a designated number of expressions from the dynamic series. The mentioned successive series are obtained in such a way that the first includes the beginning dynamic expressions in a quantity depending upon requirements or judgment. The second series includes the same number of expressions, skipping the first phrase in the first series but including the sentence immediately following after the first series and therefore the second series progresses one

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sentence ahead. In a similar manner the next successive series are composed so long as there is a possibility of creating them with a definite number of phrases. The arithmetic mean computed for each series will designate the value which we will transfer to the middle year or month of the given series. A new dynamic series, where instead of the previous original values we have inserted average values computed by this method, will represent in a graphic formulation a more even line that has been seemingly purged of strongly marked annual or seasonal variations and therefore more clearly defines the general direction of the movement for a given period.

The above method does not permit however a computation of the average values for the several last phrases in the series which perhaps represents its most important deficiency.

Table 7 presents in graphic form the development of transportation for commercial shipments, elaborated by means of the average variable, for the period 1947-1950. The basis in this formulation were numerical data from the Main Statistical Office, listed on Page 77. In comparing the appropriate table, concerned with the transportation of passengers, the development of freight shipment progressed during this same period of time almost at an even tempo.

It should also be remembered in this connection that the development of freight transportation is not in direct proportion to the increase in the total mass of products derived from harvests, production, mining and extraction, or importation. With an appropriate deconcentrated localization of extraction or production places, various materials and products (e.g., sand, gravel, certain types of stone, lime, cement, brick, wood, food items, etc) become in an

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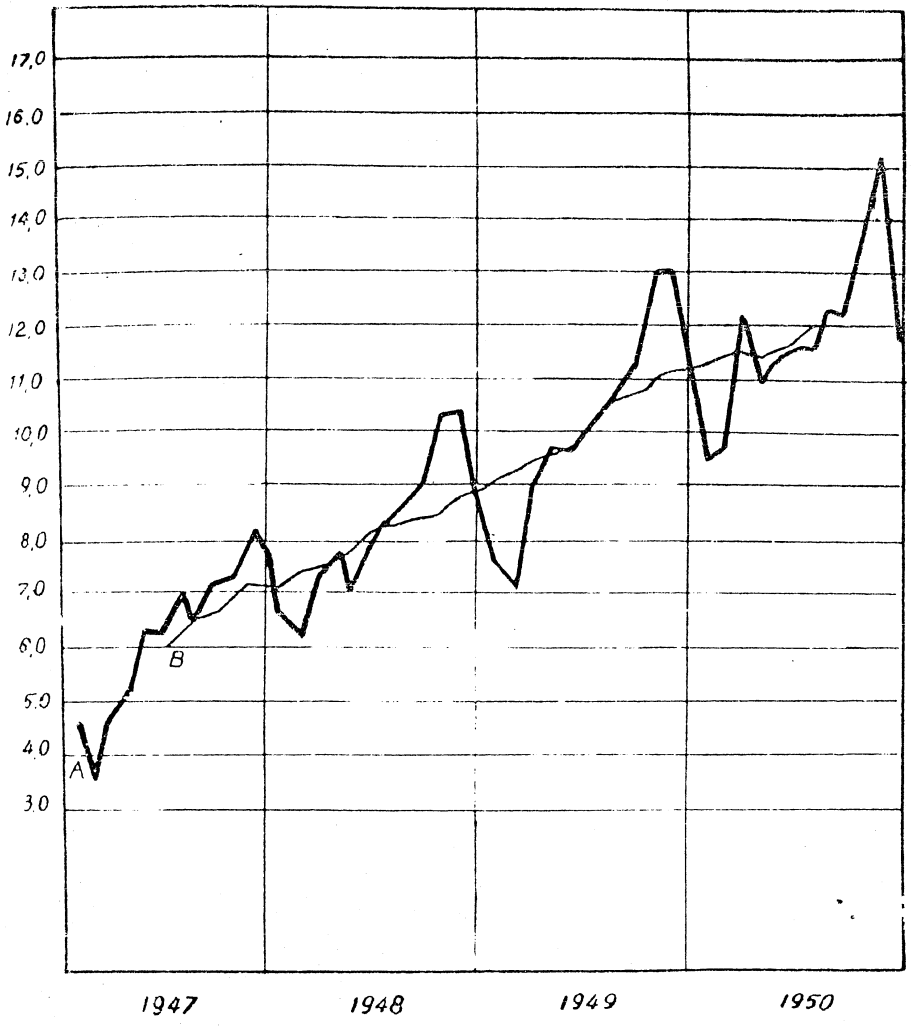
TABLE 7

DEVELOPMENT OF TRANSPORTATION FOR COMMERCIAL SHIPMENTS BY PKP 1947-1950



A, quantity of freight transported in millions of t

B, 12-month average variable for quantity "A"

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ever lesser degree the objects of transportation by railroad because deconcentration guarantees the transfer of necessary materials from closely situated sources with the assistance of road transportation media.

2. Participation of PKP in the General Transportation of Freight within the Country

Table 8 includes statistical data by percentage concerning the transportation of freight completed by the individual types of media at public disposal during the years 1948-1949.

The participation by percentage in the freight mass as a rule does not correspond to the percentage share for the implementation of related runs. This should be ascribed to the different formulation of the average distance to transport one t of consignments in the individual types of shipment. This also explains why for example the percentage participation of a truck in the fulfillment of runs increases at a much slower rate than its share in the total freight mass.

TABLE 8

PARTICIPATION BY PERCENTAGE FOR INDIVIDUAL MEDIA OF TRANSPORTATION IN SHIPMENTS FOR PUBLIC USE, COMPLETED IN POLAND DURING THE YEARS 1948-1949 TRANSPORTATION OF FREIGHT

Transport Medium	Mass Shipped (in %)		Runs of Freight (in %)	
	1948	1949	1948	1949
PKP (normal gauge railroads and connecting ones)	96,751	94,053	98,827	98,510
Transport by public truck (PKS* and other)	2,770	5,594	0,385	0,484
Inland navigation	0,472	0,346	0,786	1,004
Air transport	0,007	0,007	0,002	0,002
Totals	100,000	100,000	100,000	100,000

Note. * PKS [Panstwowa Komunikacja Samochodowa -- State Automobile Communication (Administration)]

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F. Loading and Unloading of Cars

Detailed and current information concerning the number, composition, condition, and distribution of rolling stock is of decisive significance in the proper technical exploitation of railroads. The above data also encompass information on the number of freight cars, loaded and unloaded; these data indicate changes taking place in the condition of freight cars, namely the transformation from loaded car status to empty car status and vice versa.

The above information, allowing us to deduce the appropriate numerical characterization about the degree to which the working number of freight cars is being utilized, is the object of a broad, effective, and rapidly functioning reporting system which is described in greater detail under the chapter heading dealing with the statistics of rolling stock size and labor. The data from this reporting system permit the railroad administration to know in the most operative manner among others about the quantity of the mass transported over a given network, not in the most accurate numerical formulation, it is true, but on the basis of cars.

The loading and unloading of freight cars cannot be an object for investigation by the statistics of transportation which is occupied with the production of shipments. In the course of loading and unloading freight cars, we deal with a designated number of loads; however there is an absence of runs. Even more important is the fact that freight already loaded on a car may be unloaded again by the dispatcher at the dispatching station before a transportation agreement as well as, although infrequently, even after such an agreement; commodities that have been unloaded from freight cars cease to be a component part of the transportation mass at the time they are formally delivered to the recipient.

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Regardless of the foregoing, the railroads must take the most active interest in the loading and unloading of cars from the aspect of transportation, since loading operations absorb in themselves the transportation media of the railroads. Therefore the transportation process begins with these operations in fact and ends with them.

Due to the above reasons the loading of freight cars is a component part of the transportation plan and the implementation of planned loading is controlled by appropriately organized reporting which is discussed in the following subhead "G."

Freight cars loaded at stations in one's own network, regardless of whether the load is of local origin or whether it is a load from some other transportation medium -- such as a truck, a vessel, a car from a narrow or broad gauge railroad, etc -- are counted among the numbers of cars loaded.

The number of unloaded freight cars is also computed is an appropriate manner.

The quantity of freight cars loaded or unloaded during a given period of time may be expressed by means of an absolute summary figure or in the form of an average daily quantity. Freight cars, regardless of their loading capacity or the number of axles, are computed in this connection in a natural (units) manner.

On the railroads of the USSR, the two-axle freight car has been adopted as a unit for counting loaded and unloaded cars; a four-axle freight car therefore is counted as two units. Such a method in the counting of car units provides more accurate information in connection with the number of tons in freight for these cars.

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The number of loaded freight cars during a given period of time as a rule deviates considerably from the number of unloaded cars, if we take into consideration a designated station, sector, or part of the railroad network. These figures will approach each other however if the computation deals with a longer period of time and pertains to the total PKP network. The complete conformity of both figures, i.e., the number of loaded and unloaded freight cars, is not permitted primarily because of the preponderance of transportation mass exported from Poland in direct communication to foreign countries in relation to the imported mass along the same lines of communication. There are still other reasons for this unevenness, though these are of less importance.

G. Reporting

As far as the transportation of freight is concerned, the PKP has organized a thorough internal reporting system which runs periodically through all organizational levels, i.e., from the stations (forwarding department) through the exploitation branches, district administrations of state railroads, to the Ministry of Railroads. The subject matter of operational reporting pertains basically to the static side of transportation since it does not include the implementation of runs. Due to the object, purpose, and deadlines this reporting process may be divided into the following two groups.

a. Reporting on Completed Functions

The organization of freight transportation requires the completion of an unusually large number of varied activities which have been established by means of binding legal transportation norms,

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tariff regulations, internal service orders, as well as instructions and administrative decisions. The quality of implemented transportation production depends to a large degree upon the correct execution of these activities.

Under such conditions it is imperative that an appropriate kind of reporting system be organized which would inform the administration about the quantity, type, and quality of activities implemented during the reporting period. Such reporting serves the following purposes:

(a) control over implementation of planned tasks and analysis of established deviations;

(b) establishment of the average load in tons which applies to one freight car or to one car axle in statistical formulation;

(c) drawing up of norms concerning the required numbers and categories of personnel;

(d) establishment of scales for premiums as well as for other service requirements.

The group discussed includes reports pertaining to the results of Poland's struggle against uneconomical shipments, the transportation of small consignments in collective freight cars, the sending of containers, adherence to loading norms, dispatching personnel, socialized commerce, etc.

It should be mentioned separately that a so-called list concerning dispatch work exists; this is a detailed and qualitatively very important report with information about the quantity and type of forwarding work completed by a station during a monthly period. It includes data on the number (in units) and quantity (in tons) of consignments dispatched, accepted, and reloaded by the

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station with a grouping into categories of shipments and types of consignments (small and carload size) as well as other implemented activities.

b. Reporting on the Control over Implementation of Operative Plans for Loading

Shipments resulting from the implementation of operative transportation plans are subject to statistical registration and become in this manner the object of periodic statistical investigation.

The organization in this field, regardless of statistical research, of a separate operational reporting system which would take place periodically along all organizational levels has the following justification.

(a) Control over the implementation of operational plans for transportation can only be effective, providing that the numerical material -- which is important for control over and analysis of implementation -- will be made accessible within a short period of time (in principle by telephone within 24 hours) which it is impossible to demand from statistics;

(b) according to the binding legal norms for shipments, the dispatcher carries mainly the responsibility for implementation of the loading plan; on the other hand responsibility for completion of the transportation rests with the railroad. Since loading of the cars still cannot be counted as transportation production and does not represent an object for shipment statistics, the control over implementation of operational loading plans should be based upon different numerical data and organized along separate reporting lines.

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Operational transportation plans as well as the related operational reporting system include not only dispatch but also arrival from abroad and freight in transit. The shipments are grouped in this connection according to 17 categories as well as on the basis of ministerial dispatch. In the reports there is of course no mention of runs. There is no doubt about the fact that the subject matter of this reporting branch is duplicated to a considerable degree along with the material treated by the statistics of transportation. Operational reporting however cannot take the place of transportation statistics due to the basic reasons already discussed under "General Information."

The monthly reports from the chiefs of the commercial services are of special importance in the control and analysis of implementation of the transportation plan. These reports represent a synthesis on the administration level of all remaining reports and they exhaustively discuss completed work, reasons why plans have not been implemented, etc.

H. Organization of Periodic Statistical Research

1. Original Documents and the Moment of Statistical Registration

The transportation document which accompanies a consignment includes bona fide notations concerning all major characteristics of a given freight volume; it is therefore understandable why the statistics of freight transportation has based statistical registration upon these transportation documents, receiving in this manner statistical material which corresponds in full to the conditions of honest and complete registration.

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A transportation document is basically a shipping letter; currently this document comprises four parts:

a. the shipping letter itself, destined for the recipient of a consignment after completion of the transportation phase;

b. a duplicate of the shipping letter which is received by the sender of the consignment as proof of dispatch;

c. the back of the shipping letter which remains at the dispatching station;

d. the shipping list which, together with the shipping letter, accompanies the consignment en route and stays at the destination stop.

Designated boxes in this four-part set are filled out by the sender of the consignment through a carbon paper, whereas the remaining boxes -- destination as well as dispatching station -- are filled out only on the shipping letter and on the list.

In this manner two original documents remain at the disposal of the railroad and these may be used as the basis of statistical registration: the back of the shipping letter at the dispatching station and the transportation list at the destination. Until they have been separated at the dispatching station, both of these documents are nothing more than copies of the shipping letter. In the course of the following activities, undertaken en route and at the destination, there are added to the transportation list other notations of considerable importance which are not apparent on the back of the shipping letter. As a result both of the primary documents discussed are of different significance in statistical registration.

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The essential characteristics of the consignment are detailed on the back of the shipping letter and apply to the moment when it has been dispatched for transportation, i.e., at the moment of so-called forwarding; the shipping route selected by the railroad is indicated according to the binding directional regulations; for this reason the back of the shipping letter may serve for statistical registration purposes only to indicate the situation at the time of dispatch.

In the transportation list on the other hand other notations are also located like (a) final corrections for weight and content of the consignment; (b) final changes in destination and distances for shipment introduced by supplementary orders; (c) the actual route for shipment of a consignment, deduced from the stamped dates on the list as well as notes made at junction stations, crossovers, and others; (d) date of arrival of consignment at destination, etc. The shipping list may thus be utilized as a basis for statistical registration:

a. as of the moment of dispatch, since the same characteristics are noted therein as in the back of the shipping letter;

b. according to the moment of arrival, since it also gives information about the characteristics established during the flow of freight at the moment of arrival.

The selection of an appropriate document is of major importance in statistical registration; for the requirements of control over implementation in the planning of loads, it is therefore necessary to apply registration in accordance with the moment of dispatch; on the other hand, for requirements connected with the final establishment of the weight and content of a consignment, the date of arrival,

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the destination, tariff distance, etc should be entered at the moment of arrival.

The organization of periodic statistical investigation by the PKP to date has not utilized the shipping list for purposes of statistical registration but only the backs of shipping letters and specifications. The reason for this situation should be sought in the fact that the shipping list, since it includes all of the notations reproducing the flow of the transportation process, was exploited above all for control and accounting purposes. It is necessary to expect however that in the near future shipping lists will become the basis for statistical registration according to moment of dispatch. In this connection the shipping list will also be utilized for the division of income from transportation of freight among the district administrations as well as for the purpose of compiling flows of freight. This will of course cause considerable changes in the organization of statistical investigation and will also influence the results of such research.

2. Statistical Material

The organization of periodic statistical research has been standardized by PKP in the so-called "Service Regulations for the Conduct of Transportation Statistics in Freight, Passenger, Baggage, and Express Consignments on the PKP." These will henceforth be called "Service Regulations" in the remainder of this subheading. The mentioned rules especially regulate:

a. statistical registration;

b. the process of shipping prepared statistical material and the formal control over this material;

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c. the appropriate use of symbols for this statistical material to correspond with accepted methods of grouping.

The service regulations include also general information about the destination and the modus operandi of mechanical accounting aids at the disposal of the Central Bureau of Transportation Statistics PKP. They however do not give the type of statistical compilations (tables) elaborated by the above CBS [Centralne Biuro Statystyczne -- Central Bureau of (Transportation) Statistics] on the basis of statistical material that has been worked up.

Statistical material, according to service regulations, includes today either appropriately symbolized and grouped backs of shipping letters or else statistical specifications prepared for this purpose.

A very frequent use of specifications as a type of statistical registration has the following justifications:

(1) the form of these specifications facilitates the inclusion within registration of all units, without exception, in the investigated collective; it has considerable importance in view of the accepted basis of complete registration in the statistics of transportation;

(2) certain types of transportation documents or their copies may not be submitted as statistical material, since they are required for control purposes;

(3) specifications facilitate the elaboration of statistical compilations and therefore make possible an increase in the speed of work; the specifications are essentially a preparatory stage for these elaborations, a stage that has been transferred to the station.

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It is necessary to remember however that the preparation of statistical specifications represents an extremely labor consuming function for the station, especially if the specifications are supposed to register a considerable quantity of characteristics required to obtain a full picture of transportation. A decrease in the number of registered characteristics hastens the compilation of specifications but statistical data obtained on this basis give a picture for shipments that is too generalized and thus not always useful. The indicated circumstances decide upon the extent to which specifications may be used economically for purposes of statistical registration.

The statistical unit which conducts statistical registration and prepares statistical material is the railroad station (forwarding department).

In connection with the requirements of planning shipments, the total transportation mass for the entire PKP network is designated as the whole sum of the three following categories of loads:

a. freight dispatched for shipment at PKP stations;

b. freight arriving from abroad by land at a PKP station as its final destination;

c. freight accepted from abroad for the purpose of transit shipment over the PKP network.

Each of the above three freight categories is of course subordinate to its appropriate grouping, which will still be discussed later on.

In order to hasten processing by CBS, stations are bound to use symbols as well as to group correctly statistical material.

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As far as the form of statistical material is concerned, service regulations establish in general that appropriately prepared backs of shipping lists are considered as statistical material for the following freight car size consignments:

commercial, for internal communication as well as communication with seaports and river ports, and

economic (see note).

([Note] Economic shipments are considered to be those which include objects and materials belonging to PKP, if the dispatcher and recipient of these consignments is a PKP organizational unit with the right of sending and receiving such consignments. Transportation of these shipments is reimbursable and the shipment costs are paid in cash or by check to the Polish National Bank. Certain car-load economic consignments (e.g., trains or construction cars, weighing cars, cranes, disinfection cars, and PKP steam engines proceeding to or from repair, etc) have shipping costs computed according to a uniform rate per axle and kilometer established for each budgetary year. Official service shipments, about which we will say more later, are considered to be those including slag, rubbish, and snow from cleaning the areas of stations, loading equipment, vegetation to plant in station areas, measuring equipment, tools for artisans, trolleys, bicycles, and railroad handcars. Service shipments are transported free of charge in exchange for service transportation letters.)

All remaining types of shipments and consignments are registered on the appropriate statistical specifications.

Statistical material in the two indicated forms is prepared by stations in the following manner.

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Backs of Shipping Letters. The following notations should be made on backs of shipping letters:

(1) statistical number of dispatch station and destination;

(2) statistical number of exploitation branch;

(3) statistical numbers of province and county, within the area of which the dispatch station and destination are located;

(4) freight number;

(5) tariff distance;

(6) weight of freight or number of square meters of loaded surface in the car, depending upon the way in which the tariff for the shipment has been computed;

(7) name of ministry to which sender is subordinate.

The name of the dispatching station as well as statistical numbers for the administration, station, the exploitation branch, province, and county are located with the aid of a stamp in the right upper corner of the transportation letter's back according to the indicated order:

Siedlce 1225 - 3 - 02 - 18

Statistical symbols placed in the above example mean:

first number -- name of DOKP;

next three numbers -- names of dispatching stations;

the next number -- name of exploitation branch;

next two numbers -- name of province;

last two numbers -- name of county.

In the box for "destination station," it is necessary to make by hand the appropriate entries of statistical symbols in a similar manner for the station of destination.

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In the box designated for a definition of the commodity, apart from the name of the freight, its statistical symbol should be given also.

The binding statistical numeration is established by service regulations under Chapter VII.

In the case of consignments dispatched on normal gauge railroads in direct communication with suburban railroads, stations should write on the backs of transportation letters the end station of the suburban train as the destination with a simultaneous designation of the contact station (transshipment) together with its statistical number. The tariff distance is given under these circumstances in the form of a fraction, where the numerator is the sector of normal gauge railroad and the denominator is the sector of the suburban railroad.

The backs of transportation letters for economic consignments are supposed to have printed on them "economic shipment." In cases when the carrying charges for these loads are computed per axle and kilometer, it is necessary to give the number of axles besides the car number.

As far as shipment of livestock is concerned and if the animals are loose, the weight of such consignments is designated for statistical purposes as follows.

(1) For one unit of larger domestic animals .....650 kg

(2) For one unit of calves under 6 months, sheep, ewes, and small pigs .....50 kg

(3) For one unit of swine (except small pigs).....120 kg

(4) For each floor loaded with various birds.....500 kg.

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In connection with shipments of hard coal and briquets made of hard coal, coal dust consignments, coke, and semicoking coal, dispatched by the Central Sales Office of the Coal Industry at stations where there exist hard coal mines, briquet plants, coking furnaces, and dispatched on the basis of a wholesale computation of shipping costs, stations draw up reporting compilations of specifications for shipments dispatched; the formula for these compilations (specifications) is provided by the service regulations in Enclosure 3.

Specifications. The station preparing a specification should mark the statistical numbers (symbols) appropriate to itself with a rubber stamp next to the heading alongside its own name, and namely the symbols for the: administration, station, exploitation branch, province, and county.

Specifications are prepared, depending upon the type of shipment and the direction of communication, according to one of four formulas, given by the service regulations in enclosures 4, 5, 5a, and 6. In this connection, the following modus operandi is binding.

a. According to the formula given in Enclosure 4, we register:

(1) ordinary loose shipments, express, and fast-express

(2) loose economic consignments

(3) official, loose and carload

(4) military, loose and carload

(5) station.

For each type among these designated shipments, statistical specifications are prepared separately, defining the category of consignment in the heading of the specification.

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Service, military, and station shipments in carload dispatches as well as loose ones are registered together on the same specification. Consignments shipped on work trains are not shown.

The vertical columns on the specification are used to group the shipments according to zones of distance in transportation.

Between the horizontal lines, we register in succession the shipments dispatched on individual days of the month; we write in the number of shipments dispatched in a given day for transportation; the weight of the consignments is broken down according to transportation zones of distance.

In the discussed specifications the type of freight carried is not registered since the so-called category statistics are not recorded for the above shipments.

It should be noticed that loose and ordinary, express and fast-express consignments include 10 to 40% of the total in shipments; by weight, on the other hand, loose shipments represent only about 2% of the total freight mass. Collective registration of loose consignments in specifications lessens therefore to a considerable degree the volume of statistical material and especially the number of registered transportation letter backs.

b. According to the formula given in enclosures 5 and 5a, the following are registered:

(1) carload shipments and loose ones dispatched from Poland to foreign countries on an international transportation letter (Enclosure 5);

(2) carload consignments and loose ones arriving in Poland from abroad on an international transportation letter (Enclosure 5a).

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Statistical specifications are drawn up for each foreign country of dispatch or destination separately, and

the PKP dispatch station enters into the appropriate columns of the statistical specification the names of border points crossed by shipments from PKP to a foreign railroad, instead of the destination station's name;

the PKP destination station fills out the appropriate columns of the statistical specification with names of border points for crossing by consignments from foreign railroads to the PKP.

Ordinary commercial shipments as well as express and fast-express commercial consignments have statistical specifications drawn up for themselves separately.

Loose and carload shipments are registered on the same specification, but in separate columns.

Distance is computed from or to the border point.

The specifications incorporate vertical columns for a grouping of shipments according to border crossing points, type of consignment (loose or carload), kind of freight (only carload shipments); for each group, we indicate in the horizontal columns the number of shipments and the total weight from dispatch or arrival for the individual days in the month.

c. According to the formula in Enclosure 6, the consignments carried in transit by PKP are also registered. Statistical specifications are compiled by stations (customs agencies) through which foreign shipments enter the PKP, separately for each country of destination.

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If consignments from different dispatching countries arrive for one country of destination, it is necessary to prepare for each of the former separately a statistical specification.

Instead of the destination station, we write into the specifications the border point through which the consignment leaves the PKP line. Distances are computed between border points for entry and exit of the shipment.

The mode for preparing statistical specifications is similar to that above described under point (b) for shipments abroad, dispatched or arrived on an international transportation letter, since the grouping of registered shipments according to all three formulas (enclosures 5, 5a, and 6) is identical as to composition and content of columns.

3. Central Compilation of Statistical Material by CBS

Stations (customs agencies) transmit statistical material, prepared and put in order according to regulations, to their exploitation branches during a period of 3 days for the preceding 10 days of a month.

The branches check this statistical material sent to them from a formal point of view and, as far as possible, also on the basis of merit. Within 8 days after a 10-day period of a month has expired, they transmit the material directly to CBS. The backs of transportation letters should be segregated according to dispatching stations in separate packages and in accordance with the direction of communication.

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The organization of periodic statistical investigation pertaining to the transportation of freight is therefore conceived on two levels: stations prepare the statistical material which is then compiled centrally for the total PKP network by the CBS. The role of branches is limited to collection functions and formal control.

It should be noted that in this subchapter we have discussed the organization of statistical research, binding upon normal gauge railroads of the PKP; in view of the lesser significance attributed to suburban railroads, we have decided not to describe the deviations introduced there.

I. Statistical Compilations and Reporting

A planned economy is closely connected with a system of reporting and statistics; this system, including its individual component parts, is based among others on an operational condition.

It is therefore understandable that a considerable part of the CBS effort is currently devoted to work on the monthly compilations of statistics, prepared for the current control requirements and the analysis of implementing transportation plans.

The principle of primacy for the plan, already discussed under "General Information," must be very scrupulously adhered to in relation to statistics within the field of transportation due to the plan's exceptional significance with respect to shipments. The transportation plan designates the basic task of the PKP, i.e., the shipping tasks, and simultaneously is the economic foundation and the point of departure for all remaining PKP sector plans; on the other hand, the transportation plan should guarantee a full satisfaction of shipping requirements for the entire national economy in the sphere of production, commodity turnover, etc.

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The close relationship of the transportation plan to the ever more complete elements originating in production plans, commodity turnover, construction, etc results in the fact that the method for compiling the transportation plan is not as yet definitively solidified in Poland but becomes more thorough from year to year. This precipitates an effect on shipping statistics for railroads, since under the conditions described it is not possible to establish in a relatively unchangeable manner the type of compilations (tables) in detail and the kind of composition that will be constantly needed in this branch of statistics for the requirements of planning.

On the basis of previously described statistical material, CBS currently is in the process of compiling for normal gauge railroads the following types of statistical compilations by month and later by year.

1. "A specification of dispatched (arrived) shipments according to type from (to) station of administration ... for the month of ... 195..." These specifications, known in general under the term "category statistics for freight shipments," are prepared by CBS separately for regular commercial consignments and separately for express ones in the individual administrative districts as well as in totals for the complete PKP network, with a grouping according to the 12 following communication directions:

   a. dispatch within internal communication
   b. dispatch to foreign countries by land route
   c. dispatch to Gdynia Port
   d. dispatch to Danzig Port
   e. dispatch to Stettin Port
   f. dispatch to other ports

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g. arrival from abroad by land route

h. arrival from Gdynia Port

i. arrival from Danzig Port

j. dispatch from Stettin Port

k. dispatch from other ports

l. in transit.

Specifications prepared on printed forms number 30 pages for regular shipments and six pages for express, with a grouping of freight into categories in the heading. An example of an accepted grouping is provided below in the form of a beginning fragment from specifications for regular consignments.

011	012	013	014	015	016	010	021	022
wheat	rye	oats and barley	buck-wheat and millet	edibles, podded	fodder, podded	other 01 groups of freight	oleagin-eous seeds; tariff positions 6a, 6b, 7, 8	seeds; tariff positions 10, 11 and 13

Above the name of each category of shipment, we place its statistical number which is comprised of three figures. The two first digits designate the number of the statistical group and the third is for the position number.

The statistical numeration of commodities is established by the service regulations in Chapter VIII which in sequence provide the statistical number for each tariff position of a commodity. For an easier designation of the appropriate statistical numeration, the regulations, in Chapter IX, contain an "Alphabetical Index of Commodities" in which the names (tariff) of commodities are given according to the alphabet with a simultaneous indication of the tariff position number and the corresponding statistical number.

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Specifications are prepared on a current basis for the preceding month reported on, and the numerical data are written into the individual columns in the form of fractions with the numerator containing the number of shipments and the denominator the number of tons. Statistical data from the individual specifications are then collected into one composite specification; in this specification, following the total sums, we write in as the last entry also the tariff runs for each type of shipment (freight).

The composite specification is sent to the Ministry of Railroads for tariff purposes, whereas the specifications according to DOKP are sent to the Main Statistical Office.

2. "The total specification for transportation of shipments on PKP during a month..." is prepared by grouping the vertical columns into commercial shipments (regular, express, others), economic, official, and total (all shipments); in the horizontal spaces according to DOKP dispatch; in the specification, we provide details on the number of shipments (in the numerator) and the number of tons (in the denominator); in the last two lines, we also give the tariff runs and the average distance for transporting one ton for each shipping group.

The specifications are received by the Ministry of Railroads for control over implementation of transportation plans and the appropriate extracts from these specifications are sent for this same purpose to the individual district administrations.

3. "Compilations of exchange among branches of freight during the month covered by the report..." are prepared by CBS on a global scale for the total shipped mass of freight as well as

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separately for each of the 17 categories of transportation groups, previously discussed in Subchapter B, "6. Grouping in Territorial Cross-Section."

Numerical data concerning dispatch and arrival are shown in tons.

Compilations are prepared on forms whose initial part was given in Table 4. In the compilations for the designated 16 groups of commodities, only carload commercial shipments are considered, whether regular or economic. The total compilation however includes also official military and station carload consignments as well as loose shipments.

The Ministry of Railroads receives the full set of compilations, whereas the district administrations and exploitation branches only get the horizontal strips relating to the dispatch of freight in their own region as well as the vertical strips for arrival of shipments.

The compilations make possible, among others, the discovery by the method of balancing uneconomical shipments resulting from the fact that freight of the same kind and of the same basic quality (e.g., ores, brick, cement, grain, potatoes, sugar beets) is exported and imported during the same period of time from (to) a given exploitation branch. In an economic formulation of transportation, there should take place either export or import of certain commodities depending upon whether the branch will export surpluses or whether it will be forced to cover a lack of a given commodity by import. The ordinance issued by the Ministry of Railroads in May 1952 includes more detailed instructions in connection with such an analysis of

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the compilations discussed as well as in the matter of procedure when establishing the fact of uneconomic shipments. Practice has proven that, in order to uncover transportation that is not economic, it is necessary to utilize a much more detailed grouping for freight being shipped; the utilization of a breakdown including 17 groups for this purpose does not permit us to establish per se in an indubitable manner whether we are really dealing with freight of the same type and of the same basic quality.

4. "Compilations of dispatched loose, official, military, and station shipments according to DOKP and RMO for one month..." are prepared with a grouping into types of consignments by vertical columns, whereas the horizontal lines are arranged according to DOKP and RMO in the same order as the compilations described above under (3).

These compilations are supplements to "compilations for exchange of freight among branches and are treated in a similar manner; they make possible a separation of so-called "other commercial and economic shipments" which are located within the global compilation of the total transported freight mass. They are not however included either within the compilations of the 16 commodity groups nor in the mentioned "compilation of loose, official, military, and station shipments."

5. "A general compilation for transportation of commercial shipments on the PKP network according to directions of communication and DOKP for one month..." are prepared with a grouping of consignments in vertical columns according to DOKP dispatch, in the horizontal lines according to 12 already known directions of communication, and in each communication with the division into carload, loose, and total shipments.

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The compilation is received by the Ministry of Railroads in its complete form, whereas the individual district administrations obtain the part applying to the dispatching on their network in order to control the implementation of transportation plans.

6. "Dispatch of basic freight groups according to ministries" refers to the dispatch in a given month of carload shipments of the commercial (regular and express) and economic types, with a grouping of the dispatch into vertical columns according to the already known 16 basic commodity groups (see point 3) and with the addition of columns for the "remaining freight" as well as the "total." In the horizontal lines we have detailed the 22 more important economic ministries to which the larger part of freight dispatchers is subordinate; for the still remaining dispatchers there is a separate line.

The compilation is sent to the Ministry of Railroads for the purpose of control over the loading plan.

7. "Dispatch according to provinces" is prepared separately for each dispatching province with a grouping into vertical columns according to destination provinces and the cities of Warsaw and Lodz. The compilations include all types of commercial as well as economic shipments with a grouping into horizontal lines according to 17 basic commodity groups (like in point 6). Quantities are given in tons.

The compilations are received by the State Economic Planning Commission, the Main Statistical Office, as well as the appropriate provinces in the parts pertaining to them for the purpose of preparing transportation balance sheets as well as for other purposes.

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8. "Specification for the transportation of freight on PKP" is prepared by the month with groupings in vertical columns according to the number of shipments, the quantity of tons, and the amount of ton-kilometers. On the vertical lines, we inscribe data for regular and express commercial, economic, military, official, and station shipments.

The compilation is designated to serve the requirements of the Main Statistical Office.

Subchapter II. Statistics of Passenger Transportation

A. Quantity of Transportation

1. Measurements

In order to define the size of transportation for passengers, statistics utilizes a simple measurement pertaining to the number of individuals as well as a complex measurement as a unit for expressing the number of runs completed. The significance of these measurements is the following.

a. Number of Passengers. The point of departure for this branch of statistics is the transportation of one person; therefore an individual from the physical point of view is a simple measurement.

b. Runs. Runs in this branch of transportation are described quantitatively with the assistance of units, expressed by means of a complex measurement which is the passenger-kilometer (also in use is the expression "person-kilometer").

According to the binding legal norms for transportation as well as the tariff regulations, fare payments for a trip are computed

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over the complete tariff distance of the total route along which the individual is actually carried. In this connection tariff runs expressed in passenger-kilometers are simultaneously runs that have been completed in fact since they are computed according to the actual route along which the passenger has ridden.

Tariff runs (passenger-kilometers) do not have their equivalent in the statistics of rolling stock work; the term "weight tons (net)" in passenger cars pertains to the weight of the travellers (computed in an agreed upon manner of course) and not to the number of passengers; it is therefore a quantity that cannot be compared with passenger-kilometers.

2. Definition of Transportation Quantities

a. The Number of Transported Individuals. The number of people carried is established in an intermediate manner, i.e., on the basis of notations on tickets sold; such reporting is conducted by dispatching stations (ticket windows). It is accepted therefore that an issued ticket has been actually used for transportation which is not always in accordance with the actual state of affairs.

In transportation of individuals, we are concerned not only with dispatching but also with arrival and the process in transit; due to the lack of appropriate reporting at end stations, the size of arrival and transit can only be deduced on the basis of reporting notations by the dispatching stations, since statements are noted there on tickets sold.

The binding subject matter of transportation plans incorporates only one position, i.e., that of "transporting passengers in millions

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of persons; in connection with the above discussions, the mentioned "transportation of travellers" should be understood in regard to the total PKP network as

dispatch of passengers at stations in the PKP network;

arrival of passengers at PKP stations from abroad;

transit through the PKP network.

In Subchapter B ("3. Grouping According to Types of Movement") we discussed in greater detail the causes why, on the basis of the current organization in statistical research, only the number of dispatched passengers is designated on the individual parts of the PKP network (in administrations, branches) and why it is impossible to define the numbers for arrival and transit in internal communication.

b. Runs. Runs expressed in passenger-kilometers take into consideration the actual transported route and are therefore used to designate the quantity of production actually completed as well as disposed of.

3. Characterization of Transportation Quantity

The derivative numerical characteristics, which are utilized by the statistics of transporting passengers in order to characterize the size of these loads, are similar in their construction to appropriate derivatives known already from the statistics of freight shipment. They also are of similar importance.

The following belong to these numerical characteristics:

(1) the average distance for carrying one person in kilometers;

(2) the efficiency factor of transportation for one kilometer; the value of the factor is computed by dividing the number of passengers

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dispatched on a designated line (network) during a given period of time by the exploitation distance of the line (network) expressed in kilometers;

(3) the factor of transportation efficiency per inhabitant;

(4) the factor of transportation efficiency for individuals per kilometer; the value of the factor is computed by dividing the number of passenger-kilometers completed on a designated line (network) during a given period of time by the length of exploitation for the line (network) expressed in kilometers.

The largest value for factors mentioned above under 2, 3, and 4 is observed in suburban regions or in highly industrialized ones, while the smallest value is found in predominantly agricultural regions.

B. Grouping of Passenger Transportation

The grouping for transportation of persons, given below, deviate in many respects from the grouping of freight shipments. This is caused equally by the peculiarity of the object being carried as well as by the PKP accepted organization for periodic statistical investigation concerning the transportation of passengers.

1. Grouping According to Types of Tickets and Tariff Reductions

Statistics encompasses within its observations only the dispatch of passengers on tickets issued by the ticket windows. Statistical registration does not therefore include passengers travelling on district tickets or on anonymous sector tickets or free passes.

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Tickets issued at station windows belong to two basic category groups; in each of these groups we can distinguish several appropriate tariff subgroupings. These are the following:

a. tickets for one-way passages or round-trips with a further grouping into tickets according to the normal tariff as well as special rate tariffs with reductions of 80%, 50%, 66%, and finally 75%;

b. monthly tickets for an unlimited number of rides with a further grouping into monthly tickets for general public, school, and employee usage.

2. Grouping According to Directions of Communication

Grouping with regard to directions of communication is differentiated among two fundamental groups:

a. internal communication and

b. communication abroad.

As far as foreign communication is concerned, we apply there a further grouping which encompasses:

(1) Soviet communication inside the country

(2) trips from Poland abroad

(3) passages to Poland from abroad

(4) rides in transit across Poland

3. Grouping According to Types of Communication

Grouping according to types of communication which is applied by the PKP includes:

a. local communication, when the dispatching station and the end station as well as the transportation route are situated within the same district administration;

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b. direct communication, when the dispatching station and the destination station are not located within the area of the same district administration.

In place of the previously binding statistical registration according to reported tickets, we have had, since 1 April 1953, registration according to the dispatching station and the distance zones for the transportation of passengers. The mentioned elimination of the end station from statistical registration precipitates the following results within the area of grouping passenger transportation.

(1) Grouping in a territorial cross-section may be implemented only according to the stations or regions of dispatch; the application of correlation tables is completely dropped due to the fact that interstation connections remain unknown.

(2) Implementation of grouping into local communication and direct communication has been transferred to dispatching stations (ticket offices); the notations about tickets issued (reports) permit the ticket windows to differentiate between transportation in local communication and in direct communication during the registration process, i.e., to register them on separate specifications with the simultaneous mention made only of distance zones instead of end stations.

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TABLE 9

TRANSPORTATION OF PASSENGERS ON REGULAR GAUGE LINES OF PKP, 1949 and 1951 --

GROUPING ACCORDING TO DISTANCE ZONES

Relative frequency expressed in percentage of numbers of passengers who have been transported by trains of a given type

Type of passenger traffic	Year	Zone Distances in Kilometers 1-6	7-13	14-20	21-26	27-30	31-40	41-50	51-54	55-60	61-70	71-80	81-90	91-100	101-120	121-140	141-160	161-180	181-200
Express trains	1949	0.2	0.7	1.3	1.6	1.2	2.6	4.8	1.5	1.3	2.3	3.7	2.7	2.9	4.7	7.6	4.8	3.0	3.8
Total of all trains		9.6	27.5	14.8	8.4	6.2	7.2	5.0	2.0	2.1	2.4	1.9	1.6	1.7	1.2	1.1	0.9	0.7	0.6
Express trains (see note)	1951	0.2	0.7	1.1	1.0	1.3	2.8	3.8	2.1	1.7	2.6	5.2	4.1	3.8	4.7	7.2	5.9	3.2	4.7
Total of all trains		8.1	28.7	13.7	9.1	6.9	7.4	5.3	2.2	2.0	2.4	1.9	1.5	1.4	1.1	1.0	0.8	0.7	0.6

Type of passenger traffic	Year	Zone Distances in Kilometers 201-220	221-240	241-260	261-280	281-300	301-350	351-400	401-450	451-500	501-550	551-600	601-700	701-800	801-900	901-1000	1001-1100	1101-1200	Totals
Express trains	1949	3.3	4.0	4.2	3.4	4.0	9.4	5.8	3.8	3.8	3.8	1.5	1.1	0.8	0.4	-	-	-	100.0
Total of all trains		0.5	0.5	0.5	0.4	0.4	0.8	0.5	0.4	0.3	0.3	0.2	0.2	0.1	-	-	-	-	100.0
Express trains (see note)	1951	3.0	4.0	3.3	3.7	4.1	7.8	4.5	3.8	3.2	3.3	1.6	0.9	0.5	0.2	-	-	-	100.0
Total of all trains		0.5	0.5	0.5	0.5	0.5	0.7	0.5	0.4	0.3	0.3	0.2	0.2	0.1	-	-	-	-	100.0

([Note] The number of persons transported by express trains amounts to approximately 1.6% of the total number of individuals carried on all trains together.)

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4. Grouping According to Distance Zones

The results of grouping according to distance zones which have been worked out in relation to the number of passengers carried during the years 1949-1951 on normal gauge PKP lines are represented in Table 9.

The following picture appears from the above table.

a. The largest number is manifested by the initial zones, i.e., those with the shortest distances; as the transportation distance grows, the number of passengers in the further zones rapidly declines.

b. If we accept the average extent of suburban movement as being 40 km, the relative frequency in the first six zones (up to 40 km inclusively) amounts to a total of 73.7% in 1949 and 73.9% in 1951;

c. If however we include for suburban communication only trips by monthly tickets (issued for distances up to 100 km), then the suburban movement according to compilations worked out in 1952 encompassed only 56.2% of the total for passengers carried.

Figures cited above under (b) and (c) prove that the transportation of passengers takes place for the most part over short distances, i.e., within the individual economic areas or suburban regions. The above mentioned numbers also prove that the inclusion as suburban communication of only trips for monthly tickets is not a criterion, because it misses a very large number of passengers who use one-way or round-trip tickets for short distance passage.

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5. Other Types of Grouping

Among the other types of grouping used for transportation of passengers and applied by the PKP, we should mention

(1) grouping according to the type of train for which a ticket has been issued, i.e., trips on express, regular passenger, or suburban trains;

(2) grouping of transportation according to passenger car class, i.e., according to classes 1, 2, and 3.

Other types of groupings are also known in this subject, e.g., according to trip destination, according to composition of transported passengers from a social point of view, etc; however they require special investigation with the use of separate registering personnel or by means of questionnaires; PKP has hitherto not undertaken such observation.

C. Analysis of Transportation Quality

The transportation of passengers takes place as a rule on passenger trains which run according to a rigid schedule and even have a component of cars that is strictly adhered to. According to the schedule, each passenger train running on a given line in an unpaired direction corresponds as a rule to another appropriate train in the opposite direction (paired).

In such conditions, the phenomenon of irregularity of loads in time does not basically cause any disturbance in the rhythm of transportation work. Periodic changes in the concentration of transportation along the whole railroad network or on designated lines precipitate merely an increase or a decrease in the population on the trains.

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This phenomenon of irregularity in the transportation of passengers according to directions has a different character than in the shipment of freight. The number of individuals riding in the same direction on a given line is almost matched during one year by the number of persons carried in the opposite direction. There occurs however frequently a shift of the return flow in time; that is to say that mass travel in one direction for vacations, to health resorts, etc results in a shift in time for the mass return from these localities.

Transportation of passengers does not submit to any regulation which could be the equivalent of the economical approach to the shipment of freight.

The above comments prove that the criteria accepted for an evaluation of the quality in shipping freight and referring to the uniformity of transportation in time and in directions as well as to the economical aspects of shipments do not apply to the transportation of passengers.

There remain still to be discussed such characteristics of quality in the transportation of passengers as speed and safety of carriers, the frequency of traffic as well as the exploitation of capacity in the passenger cars.

In contrast to freight trains, passenger trains stop at intermediate stations briefly; the speed of the trip will therefore depend primarily on the technical speed of passenger trains as well as on the convenience of connections at junction stations; this problem, as well as the problem of traffic frequency and safety of transportation, is covered by exploitation statistics.

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Numerical characteristics, permitting us to evaluate the number of passengers in passenger trains and therefore the degree to which transportation ability is being exploited in these cars, in a dynamic formulation are known as passenger number per axle of passenger car.

The value of this factor of concentration is computed according to the formula

$$Z = \frac{\sum Pl}{n}$$

where Pl is the number of completed passenger-kilometers and n is the number of completed axle-kilometers.

The value of the factor, deduced for the entire network or even for the network of individual district administrations, is a characteristic that remains too general. It requires to be concretized, i.e., one must establish the value of this factor in relationship to the individual lines or sectors. Attempts made in this direction, based upon the computation by conductors of the number of passenger travelling on individual sectors of lines, provided unsatisfactory results as far as accuracy in counting was concerned. Much more accurate results may be obtained by the establishment of passenger flows through a method worked out recently by the Railroad Scientific Research Institute.

The above factor will also be discussed in connection with the statistics of rolling stock labor.

Apart from the average population per axle of passengers car, the statistics of passenger transportation has as yet not been able to work out any peculiar derivative quantities which would characterize the quality of transportation production in this branch.

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D. Flow of Passengers

Between the concept of a freight flow and the idea of a passenger flow, there are considerable similarities. Therefore the methods for statistical and graphic presentation of freight flow may be applied appropriately to the flow of passengers.

Apart from this, the size of the passenger flow on a given sector may also be designated with the aid of the so-called frequency factor, i.e., without a simultaneous construction of the appropriate correlation table. The value of this factor is computed by dividing the number of train-kilometers, completed along a sector during a given period of time, by the exploitation length of the sector; the value of the factor deduced in this manner should next be multiplied by the average number of passengers in the pertinent trains which have been established, e.g., by having conductors count the travellers.

A numerical compilation and a graphic presentation of the passenger flow are both useful for numerous exploitation requirements and make possible or facilitate

(1) the conduct of analysis for transportation work in the individual sectors;

(2) the presentation of starting points and terminal points (sectors) for individual component parts of the passenger flow (for so-called streams of travellers);

(3) the establishment of an appropriate number of trains and their car composition (capacity) for individual lines;

(4) the establishment of an average number of passengers for trains on designated lines or sectors;

(5) the establishment of a number, type and direction for the course of so-called direct cars.

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E. Trends of Development of Passenger Transportation

In the statistics of freight shipment we discussed the methods for differentiating among dynamic series and a separate clear picturing of directional traffic over several years. These methods may also be appropriately applied to the statistics of passenger transportation. Table 10 represents the formulation of this kind of factor, deduced for the transportation of individuals by PKP railroads in 1946-1950.

Table 11 includes statistical data in percentages for the passenger transportation volume completed by the individual types of public vehicles during the years 1948-1949. It appears from this table that the percentile participation of railroads in relationship to the number of passengers carried decreases for 1949 in comparison with 1948 but increases as far as the share in completed runs is concerned; since the average transportation distance for one person in kilometers did not increase for the PKP in 1949, this proves that the average distance for transportation by means of other types of vehicles must have decreased considerably during that year; this occurred actually in automobile transportation.

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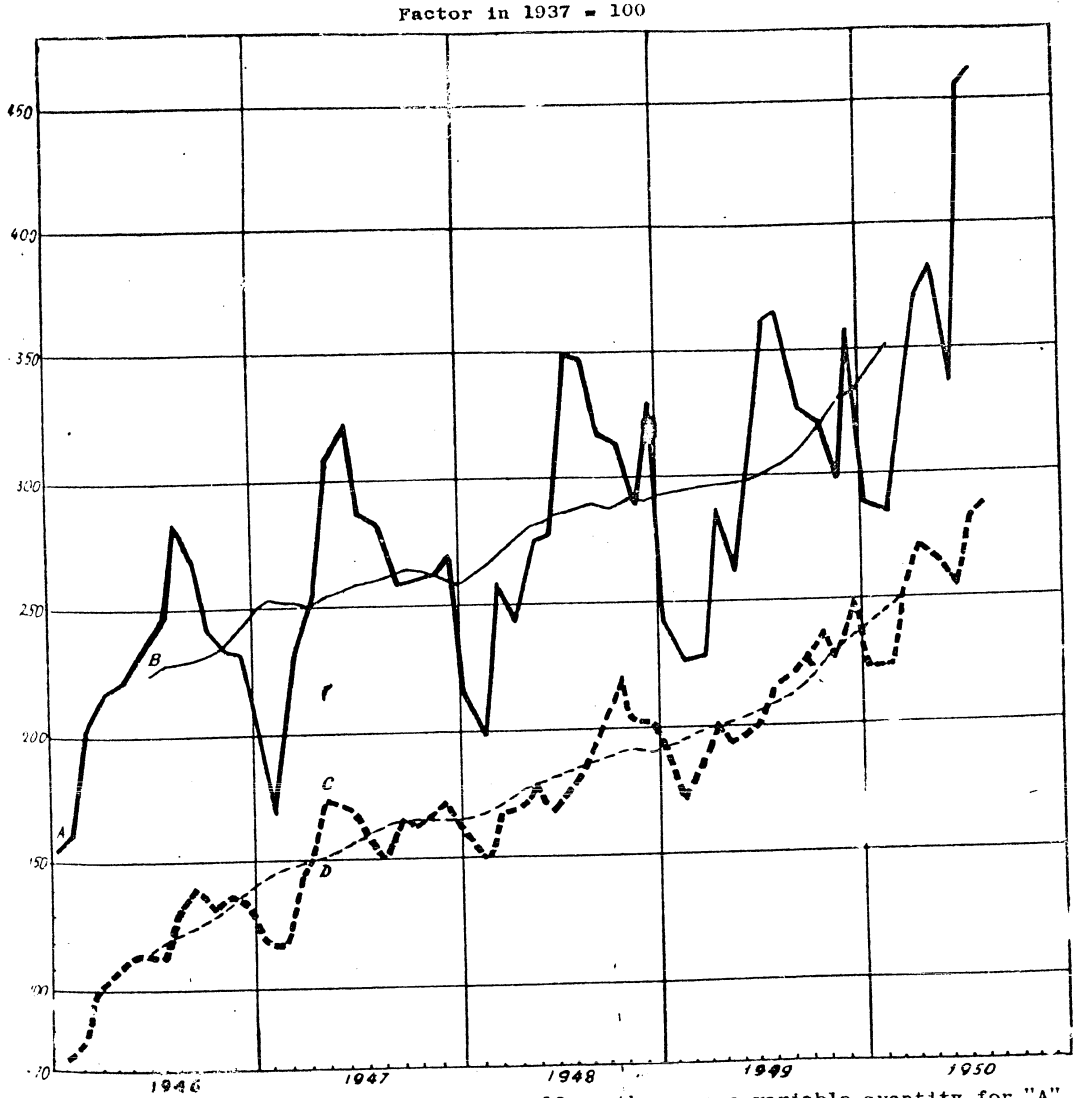
TABLE 10

FACTOR FOR TRANSPORTATION OF PASSENGERS ON PKP

Factor in 1937 = 100



A, number of passengers carried; B, 12-month average variable quantity for "A"

C, number of passenger-kilometers; D, 12-month average variable quantity for "C"

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TABLE 11

PERCENTILE PARTICIPATION OF INDIVIDUAL TRANSPORTATION MEDIA IN PUBLIC CONVEYANCES COMPLETED IN POLAND, 1948-1949

Transportation of Passengers

Transportation Medium	Number of Passengers (in %)		Runs with Passengers (in %)	
	1948	1949	1948	1949
PKP (standard gauge and suburban)	89,442	87,643	92,966	93,489
Automotive transport, public (PKS and other)	10,427	12,210	6,806	6,281
Inland navigation	0,114	0,132	0,123	0,134
Air transportation	0,017	0,015	0,105	0,096
Totals	100,000	100,000	100,000	100,000

F. Substitute Runs

Measurements for runs in statistics of transportation are the ton-kilometer and the passenger-kilometer; the statistics of transport for freight frequently is compelled to utilize also the net (exploitation) ton-kilometer. It is known that the significance of these measures varies; also own costs computed for units of these measurements are very changeable over a period of several stages covering many years.

In certain problems it is however imperative that the total production volume carried in railroad transportation be expressed in one number, i.e., with the aid of only one measurement. Such problems include, e.g., the participation of railroad transportation in the national income, designation of the general labor efficiency in railroad transportation, the amount of own cost per unit for transportation, etc.

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As such a uniform measurement, we can accept for the above purposes the so-called substitute ton-kilometer.

During the interwar period the number of completed passenger-kilometers as well as ton-kilometers of baggage shipments and express consignments was for this purpose recomputed into ton-kilometers (tariff). This recalculation was conducted on the basis of the reciprocal relationship of unit own costs connected with the above mentioned runs.

Own costs per passenger-kilometer have decreased substantially during the postwar period and are currently about 25% lower than own costs per ton-kilometer. For these reasons substitute ton-kilometers have been computed differently during the past few years, i.e., by a simple summation of completed ton-kilometers (tariff) and passenger-kilometers.

We have already mentioned that a considerable difference manifests itself on the PKP network between the number of ton-kilometers and the number of net ton-kilometers, completed during the same period of time. The number of net ton-kilometers is larger up to a limit of 10%. Under these conditions it appears to be more justified that the total labor efficiency be expressed not in substitute ton-kilometers but in net substitute ton-kilometers; in matters of general labor efficiency, decisive importance should be attached rather to transport production actually carried out and not to [incomplete] production that has been put off.

G. Reporting

Internal reporting in this transportation branch is rather limited because it is confined basically to the known monthly specification of work by the forwarding departments; this provides

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information concerning the quantity and types of functions that have been completed regarding the dispatch of passengers as well as the dispatch, arrival, and transloading of certain consignment categories transported by trains in passenger traffic.

In relation to activities connected with the dispatch of passengers, the reports inform us about the numbers for various kinds of tickets at regular and reduced rates which have been issued by ticket offices.

DOKP also provide data on the sale of tickets through agencies of "Orbis" as well as from the sale of district and anonymous sector tickets by DOKP itself; this information appears at the end of DOKP's abstract specification.

On the basis of data in such reports about the sale of tickets, it is possible to compute and then place in the specification the total number of passengers carried during the month under review. In this connection the individual types of tickets are recomputed for this purpose in the following manner:

one monthly sector ticket	for 50 persons
one pass ticket	for 10 persons
one return ticket [round-trip]	for 2 persons
one blank form ticket for the actual number of persons dispatched on this ticket	
one monthly district or anonymous sector ticket	for 50 persons
one 6-month district or anonymous sector ticket	for 250 persons
one annual district or anonymous sector ticket	for 450 persons
others, each ticket	for one person.

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Numerical data concerning shipments of baggage by express as well as periodicals and milk and especially the quantity of consignments and their weight in kilograms are placed in the specification with a grouping as to dispatch, arrival, and transloading at junction stations.

H. Organization of Statistical Research

1. Original Documents and the Moment of Statistical Registration

An original document, including all of the elements (characteristics) necessary for a correct statistical registration, is basically the ticket for a passage. Preparation of statistical material therefore is based in this branch of statistics on reporting (sales records) which the ticket offices maintain currently (according to dates) with reference to tickets issued.

The following consequences are connected with the above state of affairs.

(1) Statistical registration is conducted exclusively according to the dispatch moment of a passenger; this moment usually matches the date of departure; as far as the moment of arrival of the passenger at the station of his destination in concerned, railroads do not maintain any records.

(2) Records kept by ticket offices regarding dispatch are also the sole source of information;

(a) about the end station for the trip (concerning the statement) and about the possible resulting passages in transit;

(b) about the number of completed trips which can be deduced from the type of ticket issued (one-way, round-trip, and seasonal tickets).

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2. Statistical Material

Transportation of Passengers

Statistical material in this branch of transportation comprise exclusively specifications prepared by ticket offices on the basis of reporting notations concerning tickets issued. Free tickets, whether they be district or sector anonymous, are not included in statistical registration because ticket offices do not issue them.

Since 1 April 1953 only departure stations (dispatch) and zones of distance for transportation are registered as statistical material; however the destination point is not registered.

Depending upon the direction of the communication, service regulations differentiate among the following two basic groups of specifications.

a. Specifications in Internal Communication. Specifications in this type of communication are prepared by stations, stops possessing autonomous ticket offices, and branches of "Orbis" PBP [Polskie Biuro Podrozy -- Polish Travel Bureau].

Stations with two or more ticket offices as well as stations to which stops are subordinate but not having autonomous ticket offices add together in the specifications numerical data from all subordinate ticket offices. Data on the transportation of passengers, from whom fares have been collected on the train as a supplement to blank tickets or for sector tickets, are included in the specifications of the station which issued the pertinent blocks of tickets.

Data are registered in the specifications concerning:

the number of passengers carried on passenger trains (Enclosure 8 of service regulations);

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the number of persons transported on express trains (Enclosure 10);

the number of season tickets sold (Enclosure 11).

Enclosures 8 and 10 have the same basic composition; in Enclosure 8 the first vertical column indicates the transportation zones in kilometers; the next vertical columns serve for a grouping of passages according to the regular tariff as well as reduced tariffs with reductions of 80%, 50%, 33%, 66%, and 75%; for the first five mentioned tariffs, the subgroupings of car classes 2 and 3 are indicated but for reduced payments up to 75% only car class three.

Zones (column 1 in specifications) should be inscribed in an increasing order, with the following divisions as far as distances in kilometers are concerned:

1 - 5	51 - 60	181 - 200
6 - 10	61 - 70	201 - 250
11 - 15	71 - 80	251 - 300
16 - 20	81 - 90	301 - 350
21 - 25	91 - 100	351 - 400
26 - 30	101 - 120	401 - 500
31 - 35	121 - 140	501 - 600
36 - 40	141 - 150	601 - 800
41 - 45	151 - 160	801 - 1000
46 - 50	161 - 180	1001 - 1200

In the column for transportation according to regular tariff, it is necessary to list also passages to and from vacations; in the column for trips according to the table of payments with a 33% reduction, transportation on round-trip vacation tickets should also be entered by counting one ticket as two persons.

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Specifications designated for the registration by number of passengers carried on express trains (Enclosure 10) are filled out similarly to those specifications already described for transportation on passenger trains, with the difference that numbers of persons dispatched according to the table of payments with a 75% reduction are not shown; on the other hand numbers of passengers transported on first class tickets are also indicated in the column "according to regular tariff."

In the above specifications there should be included not only transportation of passengers on regular and reduced tickets with payments in cash but also the trips of persons with tickets on credit.

Monthly tickets available to the general public as well as school and worker tickets (class 3) are registered on specifications of tickets sold seasonally (Enclosure 11), with the following numerical data given:

in column 1, zones in an increasing order;

in column 2, number of monthly tickets sold for public use;

in column 3, number of monthly school tickets sold;

in column 4, number of monthly worker tickets sold.

The three types of specifications (enclosures 8, 10, and 11), indicated previously, should be prepared by the stations after the end of the month under review; on the basis of accounting reports on the sale of tickets, stations should establish the total number of persons carried in the individual zones with an appropriate grouping according to tariffs (regular and reduced) as well as according to car classes, appropriately entered the in columns to be filled out for the specifications.

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It should be noted that the specifications designated as enclosures 8 and 10 register the number of persons carried, whereas specifications No 11 indicate the number of monthly tickets sold. In order to forestall divergences which could arise from this, service regulations have established that the number of persons carried, computed on the basis of numerical data found in the specifications, should correspond to the number of persons transported on the station and exploitation branch (RMO) level; this number appears in column 1 of the specification concerning forwarding work. The currently binding method of recomputing the number of tickets sold, depending upon their type, into the number of passengers carried as given in Subchapter G, "Reporting."

When dispatching persons from regular gauge stations to narrow gauge stations, the regular gauge railroad stations list these trips in their specifications under the number of passengers carried only on the sector of regular gauge railroads, i.e., counting the distance merely to stations touching the narrow gauge railroads. To cover the remainder of the trip, i.e., the narrow gauge railroad, beginning stations prepare a separate specification which includes the rest of the distance from connecting stations to the destination on the narrow gauge railroad. If the number of such trips is small, it is unnecessary to prepare an additional specification; it suffices to locate the numerical data at the bottom of the appropriate specification.

The described statistical specifications on the number of persons carried are also prepared by branches of "Orbis" PBP for tickets sold by offices of these branches.

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b. Specifications in Foreign Communication. Statistical specifications in foreign communication are prepared by a separate unit subordinate to the Ministry of Railroads, namely the CBRZ [Centralne Biuro Rozrachunkow Zagranicznych -- Central Bureau of Foreign Accounting] at the city of Bydgoszcz. Specifications are prepared separately for

(1) Soviet communications inside the country

(2) trips from Poland abroad

(3) trips to Poland from abroad

(4) trips in transit across Poland.

Specifications for Soviet communications within the country are prepared according to DOKP with a grouping by zones in an order of increasing distances as well as with a further grouping into classes of cars and types of trains.

For the remaining categories of communication, indicated above under (2), (3), and (4), specifications are prepared for passengers carried with an indication of PKP stations and border points or only of border points (for transportation in transit) as well as distances in kilometers with a grouping according to categories of trains (passenger and express) and car classes.

Transportation of Baggage, Express Shipments, Milk, Periodicals, Baked Goods, Dogs and Bicycles

All types of consignments enumerated in the title and transported by trains in passenger traffic are registered by the station on one common statistical specification, the formula for which is established by the service regulations in Enclosure 12.

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For such registered data this specification includes the following vertical columns: (1) zone for distance of transportation (substitutes for filling out the names of destination stations or border points); (2) baggage (number of receipts and weight in kilograms); (3) express consignments (number of express letters and weight in kilograms); (4) milk (number of shipments and weight); (5) periodicals (number of consignments and weight); (6) baked goods (number of packages and weight); (7) dogs (in numbers); and (8) bicycles and baby carriages (in units).

The individual horizontal lines in the specification pertain to the designated zones for the distance of the transportation; on the appropriate line and in the proper column we also register numerical data concerning these consignments.

3. Central Processing of Statistical Materials by CBS

Statistical specifications referring to the transportation of passengers as well as baggage consignments, express parcels, and others which have been carried by trains in passenger traffic are transmitted by the reporting stations to exploitation branches by the third day of the following month after the month under review.

Exploitation branches check the received materials and statistics from a formal point of view and as much as possible also on a merit basis; within 6 days after the end of the month being reported on they send off this material directly to CBS.

The discussed statistical material is processed at CBS not by machines but by hand. The necessity of relieving machines for other more important work was the reason why only zones of distance in transportation have been registered as statistical material since 1 April 1953 instead of destination points.

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I. Statistical Compilations

On the bais of statistical material described previously, CBS currently works out the following types of statistical compilations on monthly bases and then by the year.

a. Transportation of Individuals

(1) "Zone compilations for numbers of persons carried on monthly sector tickets" are prepared by CBS with a grouping of vertical columns according to general public, school, and worker tickets; on the horizontal lines they are arranged according to 5-km zones for a distance of up to 100 km. Numerical data are given by the compilation in the form of fractions, i.e., in the numerator the quantity of sector tickets sold and in the denominator the quantity of trips resulting from the computation as established by service regulations.

Compilations are prepared first according to DOKP forwarding department and next total compilations for the entire network. They serve for purposes of the tariff, planning, and administration.

(2) "Zone compilations for numbers of passengers transported on one-way and round-trip tickets" are prepared by CBS with a grouping into vertical columns according to the regular tariff as well as reduced tariffs by 80%, 50%, 33%, 66%, and 75%; for each tariff (except that reduced 75%) according to second and third class car facilities. On the horizontal lines transportation is grouped according to zones established in service regulations for one way trips. For each zone we indicate: (1) the number of tickets sold (equal to the number of trips), (2) the runs in passenger-kilometers; these are computed for each column and zone in such a manner that the number of tickets sold is multiplied by the average distance of a given zone in kilometers.

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Compilations are prepared separately for transportation by passenger train and separately for express trains.

The mode and purpose for preparing these compilations are similar to those given in point (2).

(3) "Specification for number of transported passengers according to administrations, tariffs and classes in passenger trains for the month of ...." as well as a similar specification for trips in express trains in which passage on one-way and round-trip tickets is grouped into vertical columns according to a regular tariff and reductions of 80%, 50%, 33%, 66%, and 75%, as well as in each tariff according to the following scheme:

second class average trip distance
third class average trip distance.

Trips for season tickets on passenger trains are grouped into vertical columns according to tickets available to the general public, schools, workers, and in each column according to the scheme:

third class average distance of trip.

The last vertical column "Total" incorporates transportation according to second and third class, and with each class the "average trip distance" is indicated.

On the horizontal lines, we find the individual DOKP dispatches, whereas the final line "Totals" indicates the number of runs in thousands of passenger-kilometers as well as the number of passengers. Specifications are prepared for tariff purposes and for planning.

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4. "The total specification for transportation of passengers (dispatched) for the month" ... is prepared by grouping in vertical columns according to the type of traffic (long-distance, local, suburban, and total), and on the horizontal lines according to DOKP dispatches. The last three lines provide the: (a) passenger total; (b) total of passenger-kilometers; and (c) average distance for transporting one person.

b. Shipment of Baggage, Express Consignments, Milk, Periodicals, and Bicycles

"The statistical specification for transportation of baggage, express consignments, milk, periodicals, and bicycles for month of ..." is prepared on one common form but in separate successive positions for each type of enumerated shipment, whereas

(a) positions for baggage, express consignments, milk, and periodicals have the same vertical columns for grouping quantities of the enumerated shipments according to zones of distance for transportation (for a distance of up to 100 km, zones of 10 km each; up to 300 km with 20 km each; to 600 km, zones of 50 km each; and finally to 1,000 km, zones of 100 km each); in the individual zones the weight of shipments is indicated in kilograms; for baggage and express shipments, a separate vertical column also includes the number of receipts or express letters;

(b) positions for bicycles have only two zone columns from one to 30 km and from 31 to 100 km; bicycles are compiled on the basis of units.

Compilations are worked out first by exploitation branches at dispatching centers, then by administrations, and finally total compositions are prepared for the entire network.

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CHAPTER III. STATISTICS ON SIZE AND WORK OF ROLLING STOCK

A. Introductory Comments

Uninterrupted and accident-free transportation work as well as the most efficient implementation of related tasks require the kind of railroad enterprise organization which will guarantee close cooperation by all services and all workers as well as the most efficient exploitation of the total available material and technical facilities. The results of these organizational efforts are shown by the productivity achieved from the rolling stock, labor efficiency, as well as savings on materials.

Exploitation statistics in the broad meaning of the term is concerned with the mentioned results of organizational work; and its branches are statistics of size and work by rolling stock, statistics of employment and wages, as well as statistics of materials.

The designation "exploitation" in its precise meaning should be understood as the destination, utilization, and maintenance of material and technical equipment of the railroads. Within such a meaning, exploitation statistics include the statistics of size and work by the rolling stock as well as material statistics.

In this chapter, we will talk about the reporting and utilization of railroad rolling stock only, namely locomotives and cars.

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Rolling stock is the basic technical transportation medium on the railroad. It is therefore clear that only a current and precise acquaintance with the size of rolling stock and its location can make possible a correct disposition of this rolling stock in order to make total use of it; without the mentioned knowledge, it is impossible to deduce the derivative figures characterizing the degree to which rolling stock has been exploited.

Statistics for the interwar period as well as the first years of the current era, referring to the size of rolling stock, include, among others, data about newly built and delivered rolling stock, about units received from repair shops, about eliminations from the inventory, etc together with detailed construction characteristics and others. This type of information concerning the inventory level of rolling stock however belongs to the statistics of permanent media.

Rolling stock used by railroad transportation as a direct working tool and which is the subject of statistics of exploitation, is comprised of a large number of different kinds of rolling stock units which are also in a condition of constant movement. Knowledge of the inventory level under such circumstances is completely inapplicable for picturing the exploitation results; for this purpose, on the other hand, it is necessary to obtain data on the size of available rolling stock, on its composition and status, as well as on its location at all times. Statistics of size with regard to rolling stock thus must apply its own peculiar methods for registering this kind of data.

Railroad rolling stock is registered according to designated date (i.e., on the basis of size at a given moment) as well as for

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a given period of time (i.e., according to size in divisions which may be e.g., 24 hours, 10 days, months, quarters, or years).

The registration method applied for a given period of time is either in the pure form (e.g., the sum of car-days or train-hours during a certain time span) or else in the form of an average quantity deduced from the registered statuses according to successive dates during a given period of time.

Example. The number of freight cars for a given month is computed as the average of the number established at the final hour of each 24-hour period during a given month.

In statistical compilations encompassing a longer period of time (e.g., a year), as a rule one provides the size of rolling stock which has been registered during the last day of the reporting period as well as the average daily size during the reporting period. In statistical compilations however which have an operational character and include short periods of time (e.g., months) one usually finds only the average daily size.

Considerable significance, similarly to the size of rolling stock, is also attached to the effective work of the railroad especially in the economical utilization of rolling stock. Correctly organized, complete, and punctual reporting with regard to the work of rolling stock is thus indispensable in the operational conduct of the transportation process as well as for control and analysis of plan implementation.

It is the duty of the railroad to fulfill planned transportation tasks and in case of need to overfulfill it with the smallest consumption of material and technical facilities, i.e., among others with the least possible amount of rolling stock.

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The degree to which railroad rolling stock is utilized defines not only the quality of work by traffic service employees but also in the mechanical, highway, commercial, and electrotechnical services. All deficiencies in these services are reflected immediately in the work of rolling stock and precipitate irregular running of trains, decline in technical and commercial speed, etc.

In order to obtain complete and reliable material on the work of rolling stock, statistical observation has been organized in such a manner that it takes place in the course of operational activity, i.e., in places where the rolling stock is at work and together with the development of this work. Registration of data takes place in this connection on established forms, precisely according to binding service regulations and instructions.

Data on the composition, weight, and running of trains as well as runs of rolling stock are registered especially by conductors of trains who prepare and maintain reports on train traffic, specifications of cars belonging to the composition of trains, and specifications on the work of locomotives.

Specifications on the work of locomotives serve the district administrations as basic material for computing the runs of trains, cars, car axles, the weight of trains, weight of loads, time of travel and stops of trains, as well as other data concerning the movement of locomotives, composition and work of trains.

In order to describe the results of its research, the statistics of size and work by rolling stock had to work out and introduce a very large number of measurements and derivative characteristics of numbers.

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Among the accepted measurements are these.

1. Simple measurements which are natural units (such as the number of locomotives and cars), units of measurement, weight, and time (such as the kilometer, meter, ton, month, 24-hour period, hour, etc), and finally units of designated activity (such as the number of loaded cars, number of cars accepted into the loaded status from other lines, etc).

2. Complex measurements, serving mainly for quantitative description of the following:

a. time during which the rolling stock or its given part were occupied with work or in a designated state (like car-day, locomotive-hour, train-hour, etc);

b. work of rolling stock in the form of so-called runs.

Units of runs which are utilized by statistics for the work of rolling stock especially have as their task the quantitative description in kilometer units of:

work of rolling stock in motion, namely the number of kilometers covered by the rolling stock or its parts; here we find the train-kilometer, locomotive-kilometer, car-kilometer, car-axle-kilometer, etc;

the work of transportation by rolling stock connected with the relocation of weight shipments as well as own weight of vehicles; this measurement only appears in the statistics of railroad rolling stock in the form of the "gross ton-kilometer";

the effect of labor expressed in the statistics of rolling stock work on railroads by "net ton-kilometers" without regard as to whether the object of relocation is freight or individuals.

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3. Average measurements which are essentially and for the most part average quantities. These serve as units for the description of the degree of utilization or of quality in the work of rolling stock (e.g., the average weight of freight in tons which corresponds to one freight car or one axle of a freight car, the average number of passengers per axle in a passenger coach the average run per locomotive active during one hour, etc).

Accepted derivative numerical characteristics are average quantities (means) as well as factors of structure and concentration; these latter manifest themselves most frequently in the form of so-called coefficients.

In order to compute certain of the coefficients (e.g., concentration of traffic expressed in the number of train-kilometers, axle-kilometers, gross ton-kilometers, that apply to one km of the length of an active exploitation line for an administrative district per 24 hours) it is necessary to know the length of the exploitation line in a district (network).

For this purpose administrations establish a division of lines into sectors whose number and length depend upon the technical conditions and traffic concentration.

After the reporting month has expired, administrations prepare separately for single-track, double-track as well as triple- and multiple-track lines:

(1) specifications for all sectors in the district, active and inactive, with the indication of length in kilometers; the length of bordering sectors adjacent to other administrations for purposes of statistics in the work of rolling stock is computed to the end stations and not to the border points located beyond these stations;

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(2) specifications of sectors closed to traffic with an indication of the date closed and the renewed opening as well as length of the sectors.

From the above data the average daily exploitation length of lines active in the administrative district is deduced on the basis of the following formula:

$$D = A - /B + \frac{C_1 n_1 + C_2 n_2 + C_3 n_3}{n}/,$$

where D = average daily length of active lines, computed separately for single-track sectors, separately for double-track sectors, and separately for triple- and multiple-track sectors;

A, total length of all sectors in a district of a given type (i.e., one, two, three, or more tracks), active and inactive;

B, total length of inactive sectors during a whole month (one, two, three, or more tracks);

C_1, C_2, C_3, length of sectors or of their parts, temporarily closed to traffic (one, two, three, or more tracks);

n_1, n_2, n_3, number of days during which such sectors or their parts were temporarily closed to traffic;

n, number of days in a reporting month.

The total average daily length for exploitation of all active railroad lines in a district will consist of the sum of average daily exploitation length for active lines with one, two, three, and more tracks.

The above data are designated in round numbers.

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In the statistics dealing with the size and work of railroad rolling stock, measurements as well as derivative characteristics of numbers together create a logically connected and very broad system.

This system has the following composition in order that

(1) the individual measurements may have a simple, descriptive role designating the

(a) quantity, composition and status of rolling stock at a definite moment or for a reporting period;

(b) quantity and quality of rolling stock work during a reporting period;

(3) the derivative characteristics from numbers may serve for an evaluation of the status or attained results, i.e., as a control number for the implementation of plans as well as the guiding aspect in analysis.

In view of its peculiar technical and exploitation differences as well as the fact resulting from separate tasks in labor methods, the individual transportation media utilize separate measurement systems and separate numerical derivative characteristics.

The different construction of these systems was also influenced by the individual types of transportation in a historical sense. The younger transportation media, like the truck, possess much more uniform systems with a precise reciprocal connection for the individual elements but as yet incomplete from the point of view of method and practice.

Older transportation media possess broader systems with completed construction. Especially the system accepted universally for railroads

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includes a total of approximately 500 measurements and derivative numerical characteristics. Being the result of a certain stratification of measurements and derivative numerical characteristics in time, this system requires a more appropriate liaison among the individual elements into a uniform and thoroughly thought-out whole.

Vehicles entering into the composition of railroad rolling stock are divided into the following basic groups:

(1) cars:

(a) freight cars

(b) passenger and motor coaches

(2) steam engines, locomotives of the electric and diesel type.

The above division simultaneously designates the subject matter of statistics concerning the size and work of railroad rolling stock.

As a separate further division in these statistics it is necessary to enumerate also trains which are a unit of traffic organization that guarantees to vehicles the imperative technical conditions for the implementation of transportation work.

B. Freight Cars

1. Grouping of Freight Cars

Freight cars of the PKP are grouped into the following seven categories:

(1) covered cars (symbol for type K);

(2) uncovered cars with sides higher than 50 cm, so-called "coal cars" (symbol for type W);

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(3) uncovered cars without sides or with side up to 50 cm in height, so-called platform cars (symbol for type P);

(4) cars with tanks for transportation of liquids, gases, so-called tank cars (symbol for type R);

(5) special cars (symbol for type S);

(6) work cars intended mainly for the transportation of mass freight in connection with economic requirements of railroads (symbol for type X with addition of k, w, or p);

(7) economic cars without a series' symbol but with inscriptions designating the purpose of the car (first aid, sanitation, snow plows, etc); during the stop at a station, these cars are counted among those excluded from traffic.

In order to designate cars having four axles and more, instead of single letters one uses double capital letters (KK, PP, WW, etc).

Freight cars for baggage, designated by series Pt and destined for the transportation of railroad service personnel in freight trains, as well as covered freight cars equipped for the transportation of passengers (so-called "towos") belong to the freight rolling stock.

2. Number of Freight Cars

Registration of the freight car quantity, corresponding to the requirements of an economical utilization of cars, is a complex matter since the cars not only find themselves in constant movement but also frequently change their status and are converted from the so-called working quantity of cars into the group of cars excluded from traffic or vice versa and also from the number of serviceable cars to the number of cars requiring repairs or unusable cars.

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The extensive dynamics involved in the distribution of freight cars as well as the especially frequent and considerable changes in the structure of this part in railroad rolling stock cause the so-called inventory quantity of freight cars to be of little use in the requirements of car economy. The inventory quantity of cars results from the reporting of permanent media which register primarily the characteristics of a fiscal nature (quantity, degree of consumption, etc) for the given property components of enterprises.

Such types of lists (inventory) are completed at considerable intervals of time at the separate instruction of central authorities, with the maintenance of special methods of procedure.

Complementary in a way to the inventory reporting is the permanent assignment of individual freight cars to so-called home repair shops in order to execute periodic checks and repairs. The home repair shops thus have a guaranteed possibility of reporting data on completed repairs as well as notes on the status of cars leaving the repair shops; this points to the special importance of this type of reporting also from the point of view of exploitation requirements.

Data on the number of freight trains actually at the disposal of a designated railroad administration on a given day or during a given period of time are supplied separately by registration for the purpose of establishing so-called general quantities. This latter term is understood as meaning the total number of freight cars which are located within the district administration at the end of a 24-hour reporting period.

All freight cars, own as well as foreign, are included in the number.

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The total quantity of freight cars is divided into two groups:

a. number of cars excluded from traffic (W) as well as

b. number of working cars (R).

Freight cars, which for various reasons cannot be utilized for transportation, represent the quantity of cars excluded from traffic. Among these are the following cars according to types:

(a) being repaired and awaiting repair

(b) occupied for living quarters and storage space

(c) in freight trains

(d) in first-aid trains

(e) for transportation of passengers ("towosy")

(f) being searched for (also found and held in readiness)

(g) at disposal of military authorities

(h) detached and placed in the reserve

(i) hired out for transportation in the area of side spurs

(j) in constant use by other institutions

(k) being disinfected or awaiting disinfection

(l) included in the freight category

(m) single cars transferred to exclusive use by individual services.

The remaining freight train cars, used for the implementation of transportation, comprise the working quantity (R) or the number of active cars.

The working quantity (R) is obtained by subtracting the number of cars excluded from traffic from the general, total quantity (R=O-W).

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3. Registration of Total Quantity of Freight Cars and the Average Daily Number

The total quantity is established for the first time by listing or computing on the spot freight cars in the entire network. The processes of listing or counting the total quantity are repeated as is necessary.

During the mentioned counting of freight cars, we make note of the following characteristics primarily in the appropriate specifications:

(1) characteristics of car ownership (e.g., PKP or CFR); (2) series or category (covered, coal, platform, special, tank); (3) number of car; (4) number of axles; (5) the reason or purpose of excluding the given car from traffic (e.g., in repair, in anticipation of repair, for technical requirements of railroad, transferred to the reserve, etc).

Acceptance of cars from adjacent administrative districts and from foreign railroads as well as delivery of cars to adjacent districts and foreign railroads, after the hour fixed for the completion of the list, is registered by designated contact stations (intraadministration and border) for each 24-hour reporting period separately.

Cars accepted during the first 24-hour period after the reporting period are added to the number of the first total quantity. From the obtained sum, we subtract the cars released during the first 24-hour period after the listing has been made. The difference obtained will represent the total number of cars on hand at the final hour after the 24-hour reporting period in a given administration.

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We similarly designate the quantity as a total at the end of each successive 24-hour reporting period, i.e., by adding the accepted cars during the reporting period of 24-hours to those remaining from the preceding 24-hours and subtracting the number of cars released during the same reporting period of 24-hours.

The total quantity of cars on the entire PKP network is established in such a manner that the cars accepted from adjacent railroads during the first 24-hour period after the listing is added to the number of the first total for the entire PKP network and then from the obtained sum we subtract the cars released abroad during the first reporting 24-hour period after the listing.

The general total for cars on the entire PKP network during the final hour of a given reporting period of 24-hours may also be obtained by adding the total quantities for the individual administrations.

When designating the total quantity, administrations should take into consideration the changes which have taken place during a given 24-hour period of reporting in the inventory of cars, i.e.:

a. newly rebuilt own and foreign cars incorporated into the PKP rolling stock are added to the total of accepted cars;

b. foreign cars excluded from the PKP rolling stock as well as own cars withdrawn from inventory are counted in the sum of released cars.

The Ministry of Railroads conducts accounting for the transfer of cars from the PKP to foreign railroads and vice versa; it also establishes daily the total quantity, separately for own cars and separately for foreign cars on the entire PKP network.

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Total quantities, computed in the above manner, i.e., by accounting the transfer of cars, may be designated as arrived at through the balance sheet method.

Independently of this, exploitation branches as well as stations also conduct different forms of registration for freight cars which are of auxiliary and control significance in relation to the above presented basic registration.

It is necessary to include here

(a) a registration of arrived and dispatched cars, conducted by the larger stations;

(b) a registration of freight cars for dispatch from the station (disposition);

(c) accounting of cars excluded from traffic due to damage or close deadline for periodic check, conducted by stations with the headquarters for repair shops and steam engine works as well as by collective or delivery stations;

(d) record book listing damaged PKP and foreign cars;

(e) reports on the work of cars, announced by exploitation branches and including data concerning the work quantity and cars excluded from traffic;

(f) numerical specifications for cars excluded from traffic, maintained by stations separately according to each of the causes for exclusion.

The already described total quantity for freight cars represents the quantity at a designated date.

On the other hand, the quantity of cars for a given monthly period of reporting is found in the so-called "quantity of freight cars by daily average in the month being reported on."

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Similarly to the total quantity, also the average daily quantity differentiates among:

(a) the total number of cars with a breakdown into covered cars, coal cars, platform cars, tank cars, and special cars;

(b) cars excluded from traffic (for repair, reserve, freight, and for other purposes);

(c) the work quantity with a breakdown into cars as under (a).

The average daily quantity is computed by the following method: the sums of daily total quantities for the whole month pertaining to each category of car are divided by the number of days in the calendar month being reported upon. In a similar manner we compute the average daily number of cars in each category excluded from traffic.

As can be seen from the foregoing, registration is based upon the total quantity and designates the number of cars in natural units (pieces); it does not however take into consideration the differences taking place in the sum loading capacity of cars incorporated within the total quantity.

4. Work of Freight Cars

Every day a part of the cars in the working (active) quantity commences new work, based upon its utilization for loading after which the sequence includes transportation and unloading.

In the meaning accepted by car economy, the work of cars fulfilled by the car quantity in a given district during a 24-hour period being reported on should be understood as the sum of loaded cars on Polish stations in a district as well as loaded cars accepted from adjacent districts and foreign railroads during this 24-hours reported on.

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The work of cars in the entire PKP network is expressed in a similar manner, i.e., as the sum total of loaded cars on all PKP stations as well as freight cars accepted by PKP from adjacent foreign railroads.

The recent definition to the effect that by the work of cars one is to understand the sum of loaded cars and those accepted in loaded condition, should be accepted with the proviso that the sum of loaded cars indicates also the work of given stations.

The number of loaded cars on a given network as well as those arriving from the outside in a loaded condition presents an approximate picture of the freight mass quantity entering the given network. The facility and above all the speed of compiling data concerning the number of such cars, i.e., about the work of cars, in comparison, e.g., to the labor consuming, tedious, and long-lasting elaboration for the same purpose of transportation documents, gives this method of collecting reported data on the work of cars permanent and considerable importance in railroad statistics.

By accepting the work of cars defined in this manner also in computing the average turnover time for one car (see section 5), it becomes possible to compute the quantity of this factor already on the following day after the 24-hour period reported.

Data concerning the number of loaded cars on the Polish network during the previous 24-hours reported are compiled by stations in so-called reports about the quantity and work of cars. On this basis we also prepare similar reports by exploitation branches for district administrations and by the administrations for the Ministry of Railroads.

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5. Utilization of the Freight Car in Time

By car "turnover" we understand basically the period of time which elapses from the time the car has been placed for loading to the time it is again set for loading.

During the period of time which it takes for one turnover of a car, we can differentiate the following activities:

(1) setting a car in place for loading; (2) loading the car; (3) waiting by the loaded car for attachment to a train; (4) composition of a train; (5) run of the loaded car in a train; (6) rearranging of the train at technical stations; (7) setting the car in place for unloading; (8) unloading the car in which connection, depending upon the circumstances, the car may be set in place for loading again at the same station where it was unloaded, this ends the turnover, or else, after the unloading of the car, further activity takes place, i.e.: (9) waiting by the empty car for the composition of a new train; (10) composition of the train; (11) run of the empty car to the place of new loading together with operations at technical stations, after which the car is set in place for a new load, and the new turnover begins.

The run of a car in loaded condition or while empty as a component part of a train is registered in a sufficient manner for the requirements of statistics.

There is a lack however of reporting data on the time taken for individual activities during the period when the car is located at stations away from the train. The maintenance of such registration for each car individually, so-called numerical control, is expensive but possible to implement at stations in which the quantity of turnover does not reach over 200 cars per 24-hour period.

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District administrations therefore conduct control over the work of larger stations (junction and distribution) with the aid of quantitative and nonnumerical control. Stations designated by the administrations provide a daily ascertained average stop for each car which indicates approximately how many hours freight cars stopped at the station on a given day, without indicating however the time that each activity consumed.

The average stop for one car at a station in hours per given 24-hour reporting period is derived by dividing the sum of car-hours at the stop by half the sum of cars arrived and dispatched in the course of that 24-hour period. The sum of car-hours at stops as well as the number of cars arriving and being dispatched during a 24-hour reporting period are received by the station from the accounting of car-hours, conducted on forms including the following columns.

Hours in the 24-hour period for reporting	Number of cars		Working quantity	Stops in number of hours	Number of car-hours
	arrived	dispatched			
1	2	3	4	5	6
0	remaining from previous 24-hour period				
1					
2					
3					
4					
etc					

In column 1 of the form we designate the hours in the 24-hour reporting period beginning with 0 hour; column 2 is used to inscribe the number of cars which have arrived, whereas column 3

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includes the number of cars dispatched according to the hour of arrival and departure. In column 4, on the level with 0 hour, the quantity of work from the previous 24-hour period at the final reporting hour is listed. Work quantities for the following hours are computed on the basis of data in columns 2 and 3, adding or subtracting the balance of these two columns from the work quantity for the preceding hour (column 4).

The number of hours at stops is indicated in column 5 according to actual hours, whereby the sum of the figures from column 5 for the 24-hour reporting period should always amount to 24. In column 6 we indicate the number of car-hours for stops in the form of a product from the multiplication of the working quantity from column 4 by the number of hours in stops from column 5. After the completion of the 24-hour period, it is necessary to derive the final sums under columns 2, 3, 5, and 6.

The number of cars arrived and dispatched does not include the cars eliminated from traffic; cars received from repair and disinfection are counted among the arrivals, whereas those released from the station quantity for repair or disinfection are included among those dispatched after they have been unloaded.

Although the indicated system for registration of car-hours in stops at stations requires still numerous improvements, it can already in its current form throw light upon many problems pertaining to the time and causes for freight cars overstaying at stations as well as the effectiveness of media to combat this state of affairs.

It is necessary to notice that USSR stations apply a similar system for registration of car-hours in stops at stations, with the difference that hours of stopping are registered separately for cars used in:

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(a) loading and unloading operations;

(b) transit runs through a station without breaking up a train (change of steam engine, routed trains, etc);

(c) transit runs through a station with a rearrangement of train.

The average stop of one car in the work quantity at a designated station in hours per investigated period of time (10 days, month, etc) is deduced by summing up the car-hours at stops which correspond to the individual 24-hour periods and dividing the obtained sum of car-hours by half the sum of cars arrived and dispatched during the given period.

The average stop of one car in the work quantity in hours at stations in a designated region for an observed period of time is deduced by summing up the car-hours for stops from the individual stations in the region (branch, administration, etc) during an observed period of time and dividing the obtained sum of car-hours by half the total of cars arrived and dispatched from these stations during a given period.

In order to obtain for actual planning the average time of car turnover, a speed-up in the turnover of cars, and the imperative analysis of implementation, it is necessary to know numerical data about the average stop of one car in the work quantity not only in the above discussed general form but also in detailed form, i.e., with the following divisions:

(a) into groups of cars according to the purpose for which the individual freight cars are staying at the station, e.g., in order to implement loading operations, for transit crossing through

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the station without rearranging the train composition, for transit passing through the station with a rearrangement of the train composition, etc;

(b) into subgroupings according to the category of activities which are executed in sequence at the station by freight cars belonging to one of the groups indicated above under (a).

On larger stations (junction and disposition) where the control of work is maintained with the aid of a nonnumerical accounting of car-hours, in order to obtain such detailed information it is possible to utilize the already conducted fragmentary registration (e.g., from specifications R, No 12; R, No 13; R, No 9a), to commence the maintenance of appropriate auxiliary accounts on car-hours, or to organize a special registration of car-hours by means of a different and convenient method. The matters mentioned above require further research and uniform regulation.

The average time for the turnover of one freight car in 24-hour periods cannot be computed on the basis of data derived from an accurate establishment of the time that each activity takes in the course of the transportation process or from establishing at least the beginning moment in the turnover cycle for each car, since this would necessitate a large amount of work and the use of a considerable number of employees.

The average turnover time for one freight car is established thus in statistics by a simplified method, i.e., in support of the reciprocal relationship existing between the average turnover time, the number of loaded and empty cars entering the network (so-called work of cars), and the active quantity (working) of cars.

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The given reciprocal relationship is based on the fact that the product of the first two quantities is equal to the third quantity. If for example the daily load of cars amounts to 200 cars with an average car turnover of 12 hours, it will be necessary to have 200 x 0.5 = 100 cars for the implementation of the load; after the loading of 100 cars for the first time at the beginning of a 24-hour period, it will be possible to load them again after the end of half of the 24-hour period. If on the other hand the daily load amounts to 200 cars, the average turnover is three 24-hour periods, the necessary quantity of active cars will be equal to 200 x 3 = 600 cars; with the lapse of three 24-hour periods therefore the turnover of 200 cars will have been completed; these cars started work with the beginning of the first 24-hour period; thus the cars can be placed in position for a new load at the start of the fourth 24-hour period.

The average time for the turnover of one freight train car is computed for the district administration by means of dividing the work quantity in the 24-hour period being reported by the work of the cars, i.e., by the sum of loaded cars in one's own district as well as the freight cars accepted from adjacent districts and from foreign railroads during the 24-hour reporting period:

$$T = \frac{n}{u},$$

where: T, average time for turnover of one freight car in 24-hour periods;

n, quantity of active cars from 24-hour reporting period in own district;

u, work of cars during the 24-hour reporting period, i.e., the number of loaded cars in own district + the number accepted in loaded condition from adjacent districts and from foreign railroads.

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The average time for car turnover on the entire PKP network during a given 24-hour period is obtained by dividing the working quantity for the entire PKP network by the work of cars, i.e., the sum of loaded cars at all PKP stations and the accepted freight cars from adjacent foreign railroads during that same 24-hour period.

In case of computing the average time for the turnover of one freight car on the entire PKP network according to this formula:

$$T = \frac{n}{u},$$

the meanings of n and u will this time be different, i.e.,:

n, quantity of active cars from the 24-hour reporting period for the entire PKP network;

u, the work of cars on the entire network.

The average time for the turnover of one car for a district in any administration is considerably smaller than the analogous quantity for the entire PKP network under normal conditions. This is the result of many causes such as the following.

(a) In direct communication the turnover of a car in the network of a district is only a component part of the complete car turnover on the entire PKP network and it follows that the average run of a freight car in a train is smaller on the district network that for the whole PKP network.

(b) A train with a given freight car is rearranged on the district network at a smaller number of technical stations than on the entire PKP network.

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(c) The network of a given district includes as a rule only one of the loading-unloading operations, i.e., either loading or unloading.

The smaller value for average turnover time of one freight car per single administrative district also results from the computation method. When scrutinizing the entire network, the denominator "u" expresses the number of loaded cars in the whole network - those accepted from foreign railroads in loaded form. When observing only one district administration, the denominator "u" expresses the number of loaded cars in one's own district - freight cars accepted from adjacent foreign railroads + those accepted in the same condition from adjacent districts. The size of the denominator increases appropriately by this last group of cars in case of computations by district administrations, as a result of which the expressed quantity becomes smaller on the basis of the above mentioned formula.

Administrative districts differ from one another by the network length, number of technical stations, character of traffic, concentration in the work of cars, etc; as a result of such conditions, we can only compare the average turnover time for one car and in the same district administration for varying periods of time.

The average turnover time for one freight car is one of the most important factors characterizing exploitation work on networks. Among the leading tasks of exploitation therefore is the intensification of car turnover for the purpose of increasing the loading capability of the rolling stock which is accompanied usually also by increased transportation ability.

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The already described one-sentence formula for the derivation of the average turnover time of one freight car in 24-hour periods represents considerable inconvenience for the requirements of planning, control, and analysis of implementation. In this formula the numerous factors which in reality condition the turnover time of cars are not taken into consideration.

We are already acquainted with the analytical series of scientifically developed formulas, consisting of from two to seven parts, which correspond with the mentioned requirements, i.e., they take into consideration in one or another manner those factors that influence the turnover time of cars.

Planning the average turnover time of cars on the basis of one such complex formula cannot take place however before the appropriate reporting system has been organized in connection with the stops of the various above mentioned car types; such reporting will permit the establishment of a departure point for car turnover, the planning of appropriate quantities, and finally control over implementation, and the maintenance of analytical work. Preparatory work corresponding to this purpose has already been commenced by the PKP. Taking into consideration the operational requirements for influencing the formulation of the average turnover time for cars, it is necessary to accept the fact that indispensable control numbers will be collected in the future by means of operational reporting.

Additional major quantities derived, characterizing the intensiveness with which a freight car is utilized from the point of view of economizing on time, are the following: (in the following

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discussion we treat the monthly averages; in an analogous manner, it is possible to compute the averages for other periods of time: the year, quarter, 10-days, etc).

The average run (course) for a freight car in kilometers (the so-called transportation length); this quantity is derived by dividing the sum of car-kilometers, expressing the monthly run of loaded freight cars in passenger and freight trains, by the monthly work of cars.

The transportation distance expresses the average length in kilometers which a freight car in loaded status completes during one whole turnover.

The transportation distance is usually larger than the average length of shipping consignments which takes place because

(a) in cars with loose freight the transportation distance corresponds to cars in loaded condition and not to the individual consignments which usually proceed along shorter distances;

(b) the transportation distance pertains to the actual length traversed by the car which may be longer than the tariff distance, taken into account in connection with the average transportation distance of consignments.

The average run (course) for an empty freight car in kilometers is derived by dividing the sum of car-kilometers, expressing the monthly run of empty freight cars, by the monthly work of the cars.

The quantity discussed expresses the average distance in kilometers which a freight car travels during one complete turnover, when the car is in an empty condition.

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The average run (course) of a freight car in kilometers during one complete turnover represents the sum of an average car run in a loaded condition as well as in an empty condition (more about this in preceding sections) during one complete turnover.

The above quantity is derived according to the following formula:

$$l_{pel} = \frac{\sum nl}{u},$$

where l_{pel}, average run (course) of a freight car in kilometers during one complete turnover;

$\sum nl$, sum of completed car-kilometers (in loaded and empty condition);

u, work of cars (sum of loaded cars + those accepted in loaded condition from beyond one's own network).

The average run in kilometers for one car per 24-hour period (loaded and empty) is computed by dividing the sum of car-kilometers, expressing the monthly run of loaded and empty freight cars together in both passenger and freight trains, by the average monthly quantity of all freight cars at work; the obtained quotient should be divided by the number of calendar days in the given month.

According to Soviet sources the size of this average is computed differently, i.e., the run of a car during the time of its single turnover is divided by the number of 24-hour periods of car turnover.

The average work time of freight cars in trains per 24-hour period, expressed in hours, is derived by dividing the average run per 24-hour period of the loaded and empty freight car (see above) by the average commercial speed for freight trains.

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The above method of computing provides only approximate results. In order to obtain a precise quantity for the average work time of a freight car in trains per 24-hour period, it would be necessary to divide the average run in kilometers per 24-hour period of a loaded and unloaded freight car by the average commercial speed of freight cars and not by the average commercial velocity of freight trains. Binding regulations concerning the statistics of rolling stock work did not foresee however the separate derivation of the average commercial speed for freight cars. Therefore it has become necessary to substitute a related quantity for this velocity, i.e., the average commercial speed of freight trains.

6. Empty Run of Freight Cars

During each complete turnover, a freight car completes a loaded run (course) and an unloaded or empty run or else only a loaded run, depending upon whether a renewed loading will take place at the unloading station or whether the car must be transferred to another station for this purpose.

There are administrative districts with a large predominance of unloading; from there empty cars must be removed and transferred to districts where a predominance of loading occurs. In this manner flows of empty cars originate as a normal phenomenon and in connection with the distribution of production areas as well as disposal areas.

The size of an empty run is designated by relative numbers (or by percentage), expressing:

(a) the relationship between the run of loaded and empty cars together and the run of loaded cars;

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(b) the relationship of empty car runs to the runs of loaded and empty cars together.

Both of the above factors designate the same phenomenon and differ only in the method of computation.

If we were to subtract the sum of one from the relative number, indicated under (a), we would obtain the relationship of runs for empty cars to the runs for loaded cars; this latter relationship is used, e.g., in planning and statistics by USSR railroads.

Average Turnover Time. A larger percentage of runs for empty cars indicates an increase in transportation work in comparison with completed net shipping production and vice versa, a smaller percentage of runs for empty cars means a saving in transportation work, i.e., implementation of production with a smaller investment of labor. Such savings are obtained by selection of the shortest transportation routes for empty cars, mobilizing local freight for transportation on empty runs, elimination of counter-runs by empty cars in the same category, etc.

7. Utilization of Loading Capacity in Freight Cars

The degree to which the loading capacity of freight cars is being utilized can be characterized either by a static or by a dynamic measure.

A static measurement is a regular arithmetic mean, expressing the average weight of a load in tons and applying to one freight car. This type of measurement, at times designated as "the average static load per one freight car in tons," is computed by dividing the transported mass (in tons) of a given network by the corresponding

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sum of loaded cars on the same network as well as of those accepted in a loaded condition from other networks.

The static measurement may also be computed and expressed in terms of the average weight of the load in tons per one axle of a freight car.

The average weight of a load per car in tons is a changing quantity, depending upon the loading capacity of freight cars entering into the composition of rolling stock, the spaciousness and length of the cars, the categories of freight, etc. The observed quantities of this average indicate a tendency to increase from year to year. This is the result of efforts undertaken toward a better utilization of the loading capacity in cars as well as an expression of progressive changes in the average loadability of freight cars due to the systematic growth in the participation of cars with larger loading capacity.

The size of this average also indicates frequent changes, for the most part seasonal, depending mainly on the category of transported freight. Certain of these shipments, especially space-consuming and the loose type, do not permit a full utilization of car capacity in terms of weight although the capacity of the car from the spatial point of view could be totally utilized.

The static measurement is characterized by a utilization of car capacity primarily from the point of view of the transported mass; it does not however refer to the use of the car capacity in its meaning as the relationship between the car work (car run) and the result of this work, i.e., the freight run. In order to characterize this qualitative aspect of car work, we have the

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dynamic measurement which expresses the average weight of a load in tons per loaded car or per axle of a freight car in the course of a run. This measurement is also called the dynamic load of a car (or of a car axle).

The two averages indicated above are derived by dividing the monthly quantity of net ton-kilometers of freight, transported in freight cars by passenger and freight trains, by the monthly run of loaded freight cars in these trains or by the monthly run of loaded axles in freight cars of these trains which is expressed by the formula:

$$P_d = \frac{\sum P\,l}{\sum n_S}$$

or else

$$P_d = \frac{\sum P\,l}{\sum ns}$$

where P_d, dynamic measurement for utilization of car capacity (average weight of a load in tons);

Pl, completed net ton-kilometers;

nS, run of loaded cars in car-kilometers;

ns, run of loaded axles of cars in car-axle-kilometers.

The above formula permits the deduction of another also characteristic relationship, i.e.,

$$\sum ns = \frac{\sum P\,l}{P_d} .$$

On the average load weight in tons per axle of a freight car in the course of a run is dependent therefore the number of car-axle-kilometers ($\sum$ ns) imperative for implementation of a given transportation task expressed in net ton-kilometers and thus also the quantity of exploitation expenditures and the amount of car work.

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The quantity, expressed through a dynamic measurement, of utilization in car loading capacity is the weighted arithmetic mean; in this connection the "weights" are the runs of loaded cars or the runs of axles of loaded cars. The relationship to the quantity of the run often causes the appropriate quantities expressed by the dynamic measurement to be different from the corresponding quantities derived by means of the static measurement.

For example, one axle of a car will have 6 t of freight during a run of 400 km, whereas in another car the figure will be 8 t with a run of 900 km.

The average load weight per freight car axle amounts to the following, by static measurement:

$$\frac{6 + 8}{2} = 7 \text{ t.}$$

On the other hand, using the dynamic measurement:

$$\frac{6 \times 400 + 8 \times 900}{400 + 900} = 7.38 \text{ t.}$$

The quantity expressed in the dynamic measurement is larger, according to the above example, than the one expressed in the static measurement because the car axle with the greater weight load (8 t) implemented a longer run (900 km).

The size of the dynamic measurement is influenced especially by the following factors:

(a) the category structure of transported freight

(b) composition of freight cars in rolling stock

(c) degree of utilization in loading capacity or car space.

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In case it is established that the resulting quantity of the dynamic measurement deviates from the planned quantity, it is necessary to ascertain by analysis the degree to which this deviation has been caused by the influence of one, two, or all three above indicated factors. The course of this analysis runs in such a manner that it designates successively the influence of only one factor, assuming that the remaining factors had not influenced the mentioned deviation.

The influence of the category structure upon transported loads is established by comparison between the planned mass of freight and the actually shipped mass, especially the percentage-wise participation in these two masses of freight with a large proper weight as well as loads with a small proper weight, i.e., spatial and loose freight.

In designating the influence exerted upon the composition of the rolling stock, it is necessary to establish, from the implementation for individual types of car groups, what their loading capacity was per axle in a statistical form as well as what the relative relationship (proper weight) was among these car groups, and then compare the results obtained with the composition of planned rolling stock.

The degree of utilization for loadability or capacity of cars, expressed through the average weight of the freight in tons which pertains to one axle of a loaded car in static form, depends not only upon the category structure of freight being transported but also upon the degree to which the dispatchers have conformed to the loading norms to which they are bound technically and descriptively. The degree of conformity to these loading norms

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during a reporting period may be established by computing the average weight load per axle from the static point of view, in cases where the given rolling stock composition and the given category structure of freight have conformed in full to loading norms, as well as by comparing such a centered measurement with the quantity established from implementation.

On PKP lines the utilization of car capacity, expressed through the dynamic measurement, is constantly higher than the expressed static measurement. Decisive in this connection is the export of hard coal, i.e., a mass commodity with a long run; the average distance in the transportation of one t of coal is decidedly longer on the PKP than the average for the entire remaining transportation mass.

In other transportation media, utilization of loading capacity is expressed through the relationship between the actually completed net runs and the runs that can possibly be implemented in cases where the capacity of vehicles has been totally utilized in runs with freight. On the railroad, on the other hand, the basis for construction of the appropriate measurements is not the total carrying capacity of freight cars but rather the number of cars or car-axles which weakens the analytical importance of these measurements. Such a state of affairs represents the logical consequence of accepting an otherwise convenient total quantity for the registered number of cars in natural units (pieces) but which does not take into consideration their loading capacity.

A peculiar expression for the utilization of car capacity is the relationship between the weight of the load to the tare of the car, i.e., its proper weight. The size of the freight train

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composition is limited on the one hand by the gross weight permitted on the basis of the pulling power of the steam engine and other transportation conditions and on the other hand by the length of the train with respect to the length of station tracks that must be taken into consideration. An increase in the loading capacity of freight cars without a simultaneous and appropriate increase in their length, and thus also of the train length, is attainable by means of a more favorable formulation of the relationship between the average loading weight per freight car (or per car axle) and the average proper weight of the active freight car (or the proper weight per car axle). Such conditions correspond to the newly built Soviet cars with a large loading capacity and equipped with mechanisms for automatic braking and fastening.

The average proper weight of a freight car in tons, i.e., the tare of such a car in trains, is deduced in practice by dividing the difference between the monthly run of gross weight for freight cars in passenger and freight trains and the run of net weight for loads in freight cars that are a part of these trains by the monthly run of freight cars loaded and empty in these trains.

The average tare per axle of a freight car in trains is derived by dividing as above the difference between the monthly run of gross weight in cars and the monthly run of net weight in loads by the monthly run of loaded and empty car axles.

8. Efficiency of Freight Cars

The average efficiency of freight cars is measured by the number of runs and quantity of weight per freight car axle or one car entering into the composition of a designated rolling stock quantity during a reporting period.

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Depending upon the requirements or in order to designate the efficiency of cars, we can take into consideration the cars in the total rolling stock quantity or those in the working quantity or even so-called quantity of usable cars; as runs of weight on the other hand, in which we intend to express the efficiency of cars, we can utilize net ton-kilometers (exploitation) or gross ton-kilometers. Tariff ton-kilometers are not applicable to the above computations.

The previously discussed factor for efficiency of freight cars represents together with the average turnover time for one freight car the two most important derivative quantities, characterizing from the qualitative aspect the work implemented by a designated number of freight cars during a reporting period.

C. Passenger Cars

1. Grouping of Passenger Cars

Passenger cars, because of the purpose for which they serve, are divided into the following:

(a) cars for transportation of passengers

(b) cars for transportation of passenger baggage, express, and fast consignments

(c) cars for transportation of mail

(d) cars for special purposes.

Baggage and mail cars, which were not enumerated above as a separate category, serve for the purpose of transporting baggage and mail consignments in separated compartments; they are included in the category of cars used for postal transportation.

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Passenger cars for special purposes comprise club and official cars, sleeping units, diners, cars for the transportation of the sick, and heating plants.

Passenger cars for the transportation of travelers are divided into first, second, and third class categories; there also exist mixed cars.

Passenger cars, depending upon their purpose and equipment, are designated with the series symbol which consists of capital and small letters (PKP lately has been differentiating among about 75 series).

2. Quantity of Passenger Cars

Assignments of passenger cars to the individual district administrations in numbers, depending upon the requirements of traffic, are regulated by the Ministry of Railroads.

The district administration assigns cars in the form of inventory to the individual home stations and designates garages (steam engine sheds) for them.

The inventory records on passenger cars, interpreted in terms of financial records concerning records of permanent media, are conducted by the Ministry of Railroads.

Operational records for passenger cars are maintained by the Ministry of Railroads and the district administrations in the form of "card files on passenger trains" as well as for car barns (steam engine sheds) in the form of "card files in detail on passenger cars." The cards in these files include on the obverse side columns designated for a technical description of the car; on the reverse side there are

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columns for registration of the date, place and type of repairs taking place as well as construction changes occurring, and the name of the district administration which at the given period owns the car.

The requirements of operational reporting are also served by assignment books and station books for passenger cars; these make it possible for the district administrations to obtain a grasp of the situation regarding cars, their assignment, purpose, and use. Similar station books are maintained also by home stations for passenger cars.

Car barns (steam engine sheds) at home prepare on the last day of each month for their exploitation branches and district administrations "reports on the size and status of passenger cars," while the district administrations prepare similar reports for the Ministry of Railroads.

These reports represent the basic material in statistics for the establishment of the quantity of passenger cars and are the foundation for introducing changes in card file reporting.

The quantity of passenger cars in each category is ascertained by car barns (steam engine sheds) in their reports as follows.

By adding to the quantity of inventory the borrowed cars and by subtracting the cars released, the so-called total quantity or available quantity is obtained.

The number of active cars for requirements of traffic is found by subtracting the following from the total quantity:

(a) cars eliminated from traffic for repairs;

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(b) cars excluded from traffic and transferred to the reserve on the basis of a regulation by the Ministry of Railroads;

(c) cars excluded from traffic and used for living and office accomodations as well as for other different reasons.

In a similar manner on the basis of reports from subordinate car barns (steam engine sheds), the administrations establish the quantities of passenger cars in their own districts.

On instructions from the Ministry of Railroads, a numerical listing of passenger cars is conducted at a designated day and hour to check:

(a) the total quantity of passenger cars on the entire PKP network

(b) the number of passenger cars belonging to PKP

(c) the quantity of passenger cars from foreign railroad boards

(d) the number of passenger cars from individual series

(e) discovery of passenger cars being sought.

All passenger cars (with the exception of those crossed off the inventory) are listed in places where they are situated at the time the listing is being conducted.

Cars in trains, which during this time are en route, are listed by the official in charge of the train.

Passenger trains, which are located beyond the borders of the country during the listing, are included in the figures of the district administrations (home).

3. Utilization of Passenger Cars

The degree to which the transportation capacity of a passenger car is utilized during a given period of time, i.e., the "population"

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of passenger cars, is designated by an average measurement, the so-called average population per passenger car axle. The average quantity for a given period of time being reported upon is derived by dividing the quantity of implemented passenger-kilometers by the total run of passenger cars, expressed in axle-kilometers.

The computation is conducted usually only for passenger cars (designated for transportation of passengers), i.e., not taking into consideration the axle-kilometers completed by baggage, mail cars, etc.

For operational purposes it is also possible to utilize the data concerning the population of passenger trains registered by conductors; frequently however these data do not include sufficient precision.

The average quantity, characterizing the utilization of the time element by the passenger car, is the average daily run of a passenger car; this quantity is derived by dividing the run of passenger cars, completed during a given period of time, by the total number of car-days of the quantity available during the same period.

The above indicated average quantities (for number of passengers and daily run) are derived separately for long-distance traffic and separately for suburban traffic because of the large differences in the character of both types of traffic and also in the average derived quantities.

The average population in long-distance traffic does not usually go above 10 persons per car axle, whereas in suburban

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traffic it is as a rule several times higher; because of this the average population for all trains with passengers together depends not so much on the degree of actual population in long-distance trains as it does upon the "weight" of suburban traffic in total.

4. Efficiency of Passenger Cars

The average efficiency of passenger cars is designated by the quantity of passenger-kilometers for a reporting period per passenger car axle or per passenger car which is a part of a designated quantity.

Depending upon the requirements or upon the purpose for designating the efficiency, we speak of cars within the total quantity (available quantity) or within the number of active cars.

Due to the causes mentioned in connection with the discussion of quantities characterizing the utilization of passenger cars, such a factor of passenger car efficiency should be deduced separately for long-distance traffic and separately for suburban traffic.

The efficiency factor of passenger cars is the most important derivative quantity, characterizing the economic effect of a designated quantity of passenger cars during a reporting period. In cases when the quantity of the discussed factor is higher than the number of passenger-kilometers, applicable to runs under normal conditions, it is necessary to evaluate negatively such a quantity for the factor from the point of view of minimum conveniences for the passenger.

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It should be added that the expression of passenger car efficiency in runs per weight (gross ton-kilometers or net) would not provide an appropriate picture because of the purpose of passenger cars.

D. Steam Engines

1. Grouping of Steam Engines

Due to the specialization in connection with steam engines, which results from their function of servicing various types of trains, steam engines are divided into the three following groups:

(1) express steam engines (P) for servicing express and fast trains

(2) passenger steam engines (O)

(3) freight steam engines (T).

In each of the above groups several types are differentiated, depending on the wheel arrangement.

Each type is divided into a number of series, encompassing the steam engines with identical construction and power. In 1948 the PKP had approximately 40 to 50 different series of steam engines.

Independently of the division explained above, steam engines for passenger purposes and for freight are divided into locomotives with tenders and steam engines without tenders, so-called tender locomotives. Passenger locomotives without tenders are used basically for suburban traffic, whereas steam engines without tenders for freight traffic are used for switching for which of course also locomotives with tenders may be used.

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2. Quantity of Steam Engines

Steam engines are assigned permanently to the district administration and within the framework of the administration to main locomotive centers; they represent the latter's inventory. The number of required steam engines is computed on the basis of the quantity of permanent trains and the constant auxiliary work of the locomotives. When computing the necessary inventory, we add to the number of active steam engines approximately 15% for substitution of locomotives under repair and about 5% as a reserve (supply).

By subtracting from the quantity of steam engine inventory those units temporarily given to another administration or main locomotive center (detached steam engines) and by adding the locomotives assigned for the time being from other district administrations or main locomotive centers (attached steam engines), we get the total quantity of locomotives in a given administration or main steam engine center.

By subtracting from the total quantity those locomotives that have been released on loan or placed at the disposal of non-railroad units, we obtain the quantity of available steam engines for a given administration or main locomotive center.

The steam engines within the available quantity, depending upon their status (fitness for work), are divided into those usable in work (fit) and those unfit for work (unfit).

Locomotives that can be used for work, depending upon the manner in which they are being utilized, are divided into:

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(1) active steam engines which execute work expressed in locomotive-kilometers;

(2) locomotives whose steam-boilers are being cleaned and which are therefore inactive;

(3) steam engines not in service but in reserve; among these are locomotives which are inactive due to lack of work;

(4) locomotives used as permanent steam boilers in connection with the cleaning of steam boilers, heating, etc;

Unfit steam engines are divided as follows:

(1) locomotives undergoing repair

(2) steam engines awaiting repair

(3) locomotives unfit for further use and awaiting elimination from the inventory (steam engines on which reports and suggestions for elimination from inventory have been made).

The average daily number of active steam engines is obtained by dividing the monthly quantity of locomotive work days for all active steam engines by the number of calendar days in a month.

A locomotive work day is considered to be each 24-hour calendar period during which the steam engine was active at least in the course of a single hour.

3. Grouping of Locomotive Work

The work of a steam engine from the physical point of view is a derivative of the pulling power of the locomotive and the traveled route in a unit of time, i.e., the velocity of the steam engine. The power of the locomotive in this meaning depends upon its weight, the efficiency of the steam boiler, as well as the power of the steam engine.

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By locomotive work in the exploitation meaning should be understood the various types of utilization of the steam engine in terms of enterprise requirements.

Statistics of locomotive work only covers the proper work of steam engines, expressed in locomotive-kilometers, which include the following:

(1) the work of locomotives in train traffic

(2) work of steam engines apart from trains.

So-called substitute work of locomotives is not designated in steam engine kilometers and is not included in statistics on the work of locomotives.

The work of steam engines in connection with train traffic, i.e., the work of a locomotive servicing trains, is divided into:

(a) basic work which is the pulling of trains, regardless of whether the steam engine will be used for pulling or else for additional power or for pushing;

(b) supplementary work which includes maneuvering of trains, the heating of a train's composition and its reserve, as well as detached travel in order to pick up a train.

Work of a steam engine apart from the train includes:

(a) station maneuvers for requirements of passenger traffic and freight traffic

(b) maneuvers for the requirements of mechanical service

(c) auxiliary work, like disinfection, heating, reserve, etc;

(d) detached travel in order to take on work, mentioned above under points between (a) and (c).

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The preceding schematic division of steam engine work requires the following explanations.

(a) Detached travel of locomotives is considered to be the run of one or several connected steam engines without a train. The locomotive en route with one or two cars should also be considered as a detached steam engine, providing that the number of axles on the attached cars together with the trucks is not higher than four. The runs of these cars and their weight are added to the work of cars in collective trains.

Locomotives which service official trains as well as school and work trains that run constantly should be included among the steam engines pulling trains regardless of the axle number.

Detached travel, for executing station maneuvers or picking up trains, is included within the category of detached travel for official traffic needs; detached travel, however, on a trial basis as well as when sending locomotives to and from repair as well as in the rearrangement of steam engines, are all included in the category of detached runs for the requirements of the mechanical service.

(b) Station maneuvers should encompass the rearrangement of cars, implemented with the use of locomotives especially designated for this purpose.

This work includes especially:

rearrangement of cars on station tracks;

pushing of trains when leaving a station;

delivery of sand, gravel, carrying away of rubbish, snow, etc within the area of the station;

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servicing of loading and unloading places for cars;

servicing of station sidings and mines in connection with travel without any reports on the trip.

(c) Train maneuvers is the name used for rearranging cars, executed by a pulling, assisting, or pushing steam engine.

(d) Maneuvers for other services means the work of locomotives implemented during the shifting of cars to shop, traction, storage, etc tracks.

(e) Locomotive work on sidings includes the maneuvering which takes place on the basis of reports on the travel from the station to the siding at localities to which the steam engines are assigned as well as from the station to mines.

(f) Auxiliary work is considered to include disinfection and the cleaning of freight cars, the heating of cars in passenger trains and similar types of work executed by steam engines especially designated for this.

Auxiliary work is included in the category of maneuvering work in the service for which it has been implemented.

(g) Reserve is considered the stopping time of locomotives under steam with a full steam engine complement, providing that the stop lasts without any interruption longer than half an hour beyond the time for stopping allowed by the travel schedule as well as a minimum of one hour during intermissions between maneuvering work.

(h) Recalculation of supplementary work and work apart from the train by the locomotive takes place according to the following

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principles: (1) all types of maneuvers (station, train, for other services) are recalculated into locomotive-kilometers, accepting one hour of work as being equal to 5 locomotive-kilometers; (2) reserve, i.e., stops of a steam engine under steam with a complete locomotive complement, is recomputed into locomotive-kilometers by taking one hour of reserve as being equal 2 locomotive-kilometers.

4. Exploitation of Locomotive Work

A modern steam engine with considerable power is a very expensive vehicle. Locomotive economy, therefore, attaches much weight to the economic utilization of the steam engine, i.e., to the execution of the most work with the fewest locomotives.

Locomotive economy especially strives for:

(a) an increase in the daily run of steam engines by utilizing locomotives at a maximum regarding time; media leading to this goal are:

increasing the velocity of trains;

increasing the number of hours of useful work by the locomotive during a 24-hour period by assignment to the servicing of one steam engine of two, three or even four locomotive complements, by appropriately equipping the locomotive sheds in traction mechanisms, by a correct organization of labor in the locomotive sheds, etc;

(b) an increase in the composition and weight of trains which enables a more effective utilization of the great power in a modern steam engine, and namely to execute the same number of runs with the locomotive but implement more gross and net ton-kilometers.

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The quantity of work executed by a locomotive is represented approximately by the following formula:

$$\sum T \; S = \sum Q \; S$$

where T - power of the locomotive at the coupling draw hook;

S - distance of the run;

Q - gross weight of the train.

From the above formula it appears that the work of the locomotive remains in proportion to the quantity of implemented gross ton-kilometers.

In this connection also, the statistics of steam engine work has primarily developed those measurements or average quantities which designate the exploitation of locomotives in time as well as the utilization of their power.

5. Exploitation of Locomotives in Time

Among the most important averages, characterizing the exploitation of steam engines in time, are the following.

(a) The number of locomotive-hours of work per one active steam engine per day is deduced by dividing the total labor time during a month for all locomotives of an administration in trains and work apart from the train in one's own area and in the area of other administrations by the number of steam engines working in an administration, and the obtained quotient by the number of calendar days in a month.

Locomotive hours are counted in this connection from the time that a locomotive reports at the control point when passing

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from traction tracks to station tracks -- until the time of passing through the control point from station tracks to traction tracks after completed work.

(b) The average daily run of one active locomotive:

in passenger trains, which is deduced by dividing the monthly total of locomotive kilometers of basic work and supplementary labor in passenger train traffic by the number of calendar days in a month being reported upon; the obtained quotient is then divided by the quantity of active locomotives, working in passenger trains;

in freight trains;

in official, economic and work trains;

in station maneuvers;

total in trains and work apart from trains,

which is deduced by dividing also the appropriate average daily number of locomotive-kilometers by the quantity of steam engines active and working in a given type of trains or in other work.

(c) The average number of train-kilometers per one locomotive-hour in train traffic:

of passenger trains which is deduced by dividing the completed train-kilometers in passenger trains with steam traction by the number of hours of locomotive work on passenger trains;

of freight trains;

of official, economic and work trains which is deduced as in the foregoing, i.e., by dividing the total train-kilometers completed in a given type of train by the appropriate sum of locomotive-hours;

of the total in all types of trains which is deduced by adding the implemented train-kilometers in passenger trains with steam traction, the total number of train-kilometers in freight traffic,

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and the total runs of official, economic as well as work trains; next the obtained sum is divided by the total number of train-hours in all types of trains together.

(d) The average run of a single active steam engine during one hour which is deduced by dividing the total monthly number of locomotive-kilometers, executed in trains and in work apart from the trains by steam engines of a given administration in its own area and in adjacent areas, by the total number of labor hours for active locomotives in the administrations.

The average velocity of a steam engine computed as above is a relatively meaningless quantity, because it refers to all active locomotives in the area and thus also encompasses steam engines occupied by train maneuvers, station maneuvers, in reserve, etc.

On the other hand, however, separate computation of the average velocity obtained by locomotives in train traffic is without significance insofar as the evaluation of traffic results is served better by use of the train velocity as a more appropriate quantity. Statistics, therefore, in terms of PKP rolling stock does not occupy itself with the average speed of steam engines in train traffic.

(e) The average time for the turnover of one locomotive. The term one complete steam engine turnover means the time from the moment of releasing the steam engine from the home locomotive shed to work in train traffic to the moment of the next release of this steam engine by the home locomotive shed. Within the time of this complete turnover the period during which the locomotive has remained inside the home shed is also counted.

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The term exploitation turnover of locomotive should be understood as meaning the time it takes to service one pair of trains, counted from the moment a steam engine has passed through the control point of its home locomotive shed in order to execute work in the traffic of trains up to the moment of return crossing by the steam engine through the mentioned control point after completion of the work.

The average time for the turnover of one locomotive in one's own active service is computed in statistics by hours, dividing the number of locomotive-hours computed during the reporting period for one's own active locomotives by the number of such steam engines released by the home locomotive sheds for work in train traffic.

If we designate the quantity of our own active steam engines with an "N," the number of released steam engines during a reporting period for work in the train traffic with a "u," the number of 24-hour periods in the reporting period with a "t," then the average time for a complete turnover of one of our own active locomotives in terms of hours (i.e., "T") may be deduced with the assistance of the following formula:

$$T = \frac{N.24.t}{u} .$$

For purposes of analysis, we specify the following components in the balance sheet of time pertaining to the average time for a turnover of one locomotive:

the work time in trains together with the time trains stop at intermediate stations;

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the time of stops at stations and at the switch locomotive shed as well as at the home station.

The average turnover of one locomotive is computed separately for the work of steam engines in passenger, freight, official, economic, and work trains.

The average turnover of one locomotive depends upon the length of sectors which the steam engines cover within a reporting period, i.e., upon the distance between the home station and stations for switching steam engines, upon the time for stops at stations as well as in home and switching locomotive sheds, as well as upon the velocity of trains.

Average run of locomotive in kilometers during one full turnover (equal to the double average distance in kilometers between the home station and switching stations of locomotives) is deduced separately for the above mentioned three types of trains according to the following formula:

$$L = \frac{\sum NS}{u},$$

where L - average run of a locomotive in kilometers during one complete turnover;

$\sum NS$ - run of trains (in locomotive-kilometers) in train traffic of a given type during a reporting period.

The turnover of the steam engine and the average 24-hour run of the locomotive are basic measurements for the exploitation of locomotives in time and simultaneously serve to compute the needs of locomotive quantity.

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6. Exploitation of Locomotive Power

Quantities characterizing the exploitation of locomotive power are:

(a) the average number of ton-kilometers gross (in thousands), implemented by one active locomotive in these trains:

passenger;

freight;

official, economic, and work;

The foregoing quantities are deduced by dividing gross ton-kilometers, executed during a reporting period by steam engines for one's own administration in each type of train by the number of locomotives active in these trains;

(b) the average quantity of net ton-kilometers (in thousands), implemented by one steam engine active in these trains:

passenger;

freight;

official, economic, and work;

The above quantities are deduced in a manner similar to that indicated under point (a), i.e., by dividing the net ton-kilometers per given type of train in a reporting period by the number of locomotives active in these trains.

7. Efficiency of Locomotives

The average efficiency of steam engines is expressed in the number of ton-kilometers gross or ton-kilometers net, implemented during a reporting period by one steam engine which enters into the total quantitative composition or into that of healthy or active locomotives.

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The factor for steam engine efficiency possesses a construction similar to the factor characterizing the exploitation of locomotive power, since the difference manifests itself only in units of relativity. To designate the efficiency of locomotives, we take into consideration the total quantity of locomotives or the number of healthy steam engines or the active ones, whereas the characteristics for exploiting the power of locomotives refers only to the active steam engines in trains.

E. Trains

1. Grouping of Trains

Trains running on PKP lines are divided into three basic groups:

(a) trains for passenger traffic;

(b) trains for freight traffic;

(c) official, economic and work trains.

Each of the enumerated basic groups is divided for statistical purposes into several categories of trains.

Trains for passenger traffic are divided into

express (courier, lux, fast, etc);

passenger, long-distance;

local;

suburban;

mixed (passenger-freight);

special, tourist.

Trains for freight traffic are divided into

consignment-express and loose merchandise of a light type;

freight-express;

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freight-regular;

freight collective, delivery, siding;

mixed (freight-passengers);

military and sanitary.

Mixed trains which appear in both the enumerated groups belong to the category of trains in passenger traffic (as passenger-freight), if they serve primarily for the transportation of passengers and in their composition possess more passenger cars than freight cars. Mixed trains, designated for the most part to transport freight and having thus in their composition more freight cars than passenger cars, are included with trains in freight traffic as freight-passenger trains.

A separate group comprises trains placed on active duty for the needs of the railroad, like official, economic, and work trains.

Official trains are divided into

first aid;

testing, experimental;

inspection.

Economic trains are those which serve for the transportation of freight exclusively for the requirements of the railroad; work trains are dispatched along the routes for loading or unloading of materials to be used in railroad work.

2. The Work of Trains

(1) From the Quantitative Point of View. The train is a separate organizational-traffic unit. This unit directly implements the transport of passengers and consignments. For this reason

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it is the object of lively attention on the part of railroad customers who are interested in the number of introduced trains, the traffic schedule, the time for runs, and the time consumed by the stopping of trains etc.

Even more important is the train to the railroad board which is the direct executor of transportation work. Several important problems are connected with this matter, problems pertaining to the capability of the transportation line, the permeability and development of the station, the length of station tracks, etc. Regardless therefore of the statistics on the work of steam engines, there arises a necessity for a separate statistics of locomotive work which would possess its own justification as well as a separate reason and purpose.

The work of trains is described quantitatively on the basis of completed runs. Due to the complex character of this work, we apply several measurements of the run to express either the traffic work of trains or else their transportation work. The derivatives arrived at from the runs pertaining to the numerical characteristics describe the average composition and weight of trains as well as the average weight of the load; they also make possible an evaluation of the degree to which the work of trains has been exploited and its quality.

The following belong to these runs:

(a) The run of trains expressed in train-kilometers; the number of completed train-kilometers does not in itself say much about the transport work executed by trains due to the large differences in their composition; it does, however, permit in the compilation with other runs to deduce certain average quantities or average measurements.

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The statistics of work by the rolling stock computes the number of completed train-kilometers by summing up the runs of locomotives in passenger traffic or in freight traffic, since the obtained results are synonymous with the run of trains; in such a way we receive the runs (train-kilometers) for passenger trains as well as freight trains in each category separately as well as together in given traffic.

(b) The run of cars expressed in car-kilometers and the run of car axles expressed in car-axle-kilometers; due to the considerable differences in the size of cars which finds an expression in the number of axles on the individual cars, car-axle-kilometers are more important for a quantitative description of work by trains.

The run of car axles in comparison with the run of trains enables us to compute the average number of axles in the composition of passenger and freight trains. The average number of axles on all cars and on passenger cars within the composition of passenger trains for each type separately as well as together in passenger traffic with steam traction is deduced namely by dividing the monthly run of axles for all cars in the given passenger cars with steam traction or else only the axles of passenger cars in these trains by the monthly run of appropriate passenger trains with steam traction.

The average number of axles in all cars and in passenger cars within the composition of freight trains of each type separately as well as together is deduced through dividing the monthly run of axles for all cars in given trains for freight traffic or else of axles for passenger cars in these same trains by the monthly run of the appropriate trains in freight traffic.

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The pertinent formula for computing the average quantity of axles in the composition of trains has the following form:

$$S = \frac{\sum ns}{\sum ml},$$

where S - average number of axles in trains;

$\sum$ ns - sum of completed car-axle-kilometers;

$\sum$ ml - sum of completed train-kilometers (locomotive kilometers in trains).

The larger the average number of axles in the composition of a train, the smaller the need for trains to transport the same number of cars as well as the same quantity of freight. The possibilities of increasing the average number of axles in connection with the length of trains are, however, limited by the length of passby tracks. One method for eliminating this difficulty is to increase the rolling stock number of four-axle cars with large loading capacity but relatively small length.

The average number of axles, describing the degree to the work of trains has been exploited regarding composition, remains an insufficient quantity also for the characterization of locomotive work. With the same number of car axles, the weight of individual trains may differ depending upon the average weight in gross tons that applies to one car axle that belongs to a loaded and empty car together. Data on the weight of trains is computed on the basis of the gross weight run in trains which will be discussed under the next point.

(c) The run of gross weight in trains, expressed in gross ton-kilometers, takes into consideration the proper weight of cars entering into the composition of trains (so-called tare),

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the weight of passengers or consignments transported in these cars, and finally the weight of the cold locomotive. The load weight in cars (regular-gauge) for passengers, mail, and baggage is considered in terms of one ton per each car axle, without regard for the actual weight of the load or the number of persons. The weight of travelers being transported in the "towosy," the weight of live shipments, and of objects accepted for transportation in freight cars according to the number of units are all computed on the basis of designated average norms which have been established in appropriate regulations.

(d) The run of net weight in trains, expressed in net ton-kilometers, takes into consideration only the weight of transported shipments (so-called net) while the weight of loads in passenger, baggage and mail cars, the weight of passengers in "towosy," and the weight of objects accepted for transportation in freight cars according to the number of units are all computed by the method indicated under (c).

The run of weight in trains (gross) and in shipments (net) is given in thousands of ton-kilometers and in whole numbers.

Data on the weight and run of trains are registered by those in charge of trains during the trip on specifications for the work of locomotives. The gross and net ton-kilometers computed from these data, therefore, take into consideration the actual route taken.

Gross ton-kilometers express the work of transportation by trains. Net ton-kilometers are the result of transportation work by trains, i.e., of the actually completed production. To picture

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the external results of activity on the part of railroad enterprises, and especially for purposes of realization (disposal), the implemented production must be designated according to tariff criteria.

On the basis of the foregoing conclusions, the following picture results in connection with the importance of tariff and exploitation runs:

Transportation of Freight Shipments

(a) ton-kilometers (tariff), when taking into consideration the net weight of consignments and the tariff distance from the dispatching (sending) station to the station of destination, designate the quantity of realized (disposed of) transportation production;

(b) net ton-kilometers (exploitation), taking into consideration the net weight of shipments and the actual transportation route, are the direct result of transportation work by trains and express the quantity of shipped production actually completed for exploitation purposes; exploitation runs, as has already been mentioned in connection with the statistics of transportation under sub-chapter "C," are as a rule several percent larger than the tariff runs.

Transportation of Passengers

(a) passenger-kilometers, taking into consideration the number of passengers and the actual route travelled as indicated on the ticket, designate the quantity of realized transportation production;

(b) net ton-kilometers (exploitation), taking into consideration the weight of passengers in cars (computed at any rate in an agreed upon manner) and not the number of travellers, express the

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result of work in transportation understood as meaning the relocation of the passengers' weight; net ton-kilometers, computed for the transportation of travellers, in practice serve mainly for the computation of the gross run weight in trains (gross ton-kilometers).

The gross run weight and net for freight in trains, compared with the run of trains, makes possible the computation of the average weight in gross for trains and in net for loads. In this connection the average gross weight of trains and the net weight of loads on passenger trains of each type separately and together used in passenger traffic (steam traction) are deduced by dividing the gross run weight in trains for passenger traffic and with steam traction or else the net of these trains by the run of trains in passenger traffic and with steam traction during the same time period (as a rule by the month).

The average gross weight of trains and the net weight of loads in freight trains of each type separately and together are deduced by dividing the run of gross weight or of net load in given trains from freight traffic by the run of these freight trains for the same period of time.

The computation of the average weight for trains in gross and in net are represented by the following two formulas:

$$q_{gross} = \frac{\sum q\,l}{\sum m\,l} \quad \text{and} \quad q_{net} = \frac{\sum Q\,l}{\sum m\,l},$$

where $\sum q\,l$ - sum of completed gross ton-kilometers;

$\sum Q\,l$ - sum of completed net ton-kilometers;

$\sum m\,l$ - sum of completed train-kilometers (locomotive kilometers in trains).

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A comparison of the average weight for freight trains in gross and the average load weight in net will enable us to evaluate the degree to which the average weight of these trains in gross are being utilized to transport freight.

2. With Regard to Quality. Similarly to the quantitative description of complex work by trains, which requires the application of several types of runs, also the qualitative characterization of this work uses several derivative numerical characteristics. Besides the above discussed derivative quantities, the quality of train work is described primarily by the average velocity of trains expressed in terms of train runs in the course of one hour's travel (kilometers per hour). The factor for the average speed of trains, depending upon whether it is technical or commercial velocity, is computed as follows:

(a) The average speed (kilometers per hour) for passenger trains in each type separately as well as together in passenger traffic with steam traction is deduced by dividing the sum of runs for the appropriate trains in passenger traffic with steam traction during a reporting period by the

number of hours for the travel itself of these trains in order to obtain the technical velocity;

number of hours for travel together with stops by these trains in order to obtain the commercial velocity.

The average speed (kilometers per hour) of freight trains in each category separately as well as together is deduced by dividing the sum of runs for appropriate trains in freight traffic during a reporting period by the

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number of hours of travel for these trains in order to obtain the technical velocity;

the number of hours of travel together with stops in order to obtain the commercial velocity.

The hours of travel together with stops includes the time from the moment of train departure at the beginning station to the moment of its arrival at the end station, i.e., the station where the train is broken up, not excluding the time for stops by the train at intermediate or disposition stations or at stations where the locomotive or group of conductors are changed; the total time for travel and stops as well as the number of hours for the travel of trains itself is expressed in train-hours which are the object of statistical registration.

(b) The work of trains within the period of one hour is designated by the product obtained from multiplying the average composition or the average train weight by the average commercial velocity of the train.

Depending upon what type of units will be used to express the weight or composition of the train (tons, cars, or axles), the work of various types of trains during an hour will be expressed by the number of completed ton-kilometers gross, train-kilometers, or axle-kilometers; the work of freight trains may also be expressed in net ton-kilometers.

On certain trains, there are also in use types of quantities which characterize the quality of work by trains like the:

number of latenesses of passenger trains, expressed in minutes per 100 train-kilometers in passenger traffic;

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relationship of actual commercial speed of trains to the commercial speed foreseen by the traffic schedule;

relationship between the commercial velocity of trains and the technical velocity (so-called coefficient of velocity), etc.

F. Analysis of Railroad Rolling Stock Utilization

In the statistics of railroads for a long time now, considerable importance has been attached to an analysis of railroad rolling stock utilization.

The analysis in this subject is based on the following.

1. The establishment of relationships between the degree of utilization of railroad rolling stock and the factors influencing this utilization of rolling stock.

2. The designation of the mentioned factors with the aid of measurements and derivative numerical characteristics which have been included in the broad system of statistics on the quantity and work of rolling stock primarily for the purpose of analysis.

The individual component parts of the system, and above all the individual numerical characteristics, are connected reciprocally with one another through a functional relationship; this relationship may be represented in the form of appropriate algebraic equations which serve analysis in a very large way.

Here are two examples of equations in this category:

1) $\frac{\sum nl}{u} = \frac{\sum nl}{n} \times T$; 2) $\frac{\sum al}{\sum n_1 l_1} : \frac{Q}{u} = a \times l : \frac{\sum n l_1}{u}$,

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where $\frac{\sum nl}{u}$ = the average run (course) of a freight train in kilometers during one complete turnover (relationship between the run of cars in loaded and empty status and the work of cars);

$\frac{\sum nl}{n}$ = the average run in kilometers of one car (loaded and empty) per 24-hour period (relationship of car runs in loaded and empty condition to the number of work cars);

T = average time for turnover of one freight car per 24-hours;

$\frac{\sum ql}{\sum n_1 l_1}$ = average dynamic load of one car in tons (relationship of net ton-kilometers to the run of loaded cars);

$\frac{Q}{u}$ = average static load of one car in tons (relationship of transported mass in tons to the work of the cars);

a = relationship of executed net ton-kilometers to ton-kilometers;

l = average distance for transportation of one ton of freight;

$\frac{\sum n_1 l_1}{u}$ = length of transportation in kilometers for one loaded car (relationship between the run of loaded cars and the work of cars).

In the foregoing subchapters, an analysis has already been presented concerning certain of the more important numerical characteristics as well as a discussion of their functional relationship to so-called factors. These factors have been as a rule appropriate numerical characteristics themselves.

Qualitative numerical characteristics, designating in a manner that is especially many-sided the degree to which railroad rolling stock has been utilized, are the following:

the average turnover time for one freight car (T) as well as

factors of efficiency for one freight car, one passenger car, as well as one steam engine (locomotive).

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The complex nature of the above mentioned numerical characteristics becomes clear from the following algebraic equations which have been compiled by a special method (The form of these equations has been taken from the work of R. Ceceniowski, M. S., entitled "The Reciprocal and Functional Relationship of Exploitation in Railroad Rolling Stock," in Przeglad Kolejowy [Railroad Review], No 12, 1952):

$$\frac{n}{u} = \frac{n}{\sum nl} \times \frac{\sum nl}{\sum n_1 l_1} \times \frac{\sum n_1 l_1}{u},$$

where $\left(\frac{n}{u}\right)$ = the average time for a turnover of one freight car (ratio of work quantity to work of freight cars);

$\left(\frac{n}{\sum nl}\right)$ = reverse of the average run in kilometers for one loaded and empty car per 24-hour period;

$\left(\frac{\sum nl}{\sum n_1 l_1}\right)$ = ratio of runs for all cars to runs for loaded cars;

$\left(\frac{\sum n_1 l_1}{u}\right)$ = average run (course) of a loaded freight car in kilometers.

It appears from the equation above that the average time of turnover for one freight car depends upon three factors, but that these factors are connected with one another by a special functional relationship which in the final result provides an average turnover time for one car designated merely by the ratio $\left(\frac{n}{u}\right)$. For an appropriate analysis, i.e., an analysis of the content expressed by static numbers, such an unfolding of a simple formula $\left(T = \frac{n}{u}\right)$ into corelated factors does not provide us with anything positive.

An equation with such a detailed form is, however, useful for the requirements of analysis which has as its aim the logical and mathematical ascertainment of correctness for statistical figures.

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Example. We have obtained from implementation:

the average run in kilometers for one loaded and empty car per 24 hours -- 72 kilometers;

the relationship between the run of loaded cars and the run of all cars -- 0.66;

the average run (course) of a loaded freight car in kilometers (length of transportation) -- 237.6 kilometers. Since the above factors are connected functionally with one another and with the average turnover time for one car $\left(\frac{n}{u}\right)$, we obtain

$$T = \frac{237.6}{72 \times 0.66} = 5.00 \text{ 24-hour periods.}$$

If it has been established in a given case from implementation, e.g., T = 4.9 24-hour periods, then under such a set of circumstances either the appropriate computation was executed improperly or the resulting quantity for the above three factors must in reality be different.

The preceding discussion leads to the conclusion that a simple formula for computing the average turnover time for one car -- even after breaking down the right side into factors -- is of little use for the requirements of a deeper analysis. This is derived from the fact that a simple formula does not occupy itself at all with the individual components of the balance sheet or with time which passes from the moment of setting the car in place for loading to the moment this same car is again set in place for the next loading. These deficiencies do not manifest themselves, however, in complex formulas which we already mentioned in sub-chapter B.

Here is one such formula (four-part) which enables us to deduce the average time for the turnover of cars during a given

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period of time within the network of a given region:

$$T = \frac{1}{24}\left[\frac{U_n + U_w}{U} \times t_o + \frac{(1 + \alpha)K_t}{v_h} + \frac{U_1}{U} \times t_1 + \frac{U_2}{U} \times t_n\right]$$

where

t_o - the average time for the period in question during which loaded and empty cars stop at loading stations within the region, deduced in relationship to one loading operation;

t_1 - the average time for the period under consideration in which one car stops at technical stations in the region (without rearranging the train);

t_n - the average time in the considered period during which one car stops at disposition stations in the region (with a rearrangement of the train);

U - the average quantity for "work of cars" at stations in the observed region during the period under review (number of cars loaded + those accepted in loaded condition);

U_n - the average number of cars loaded at all stations within the region during one 24-hour period of the considered period;

U_w - a similar average number of unloaded cars;

U_1 - the average number of cars passing through all technical stations of a region in transit during one 24-hour period of an observed time sequence;

U_2 - the average number of cars disposed of by all disposition stations in a region during one 24-hour period of the given time;

K_t - the average course in kilometers for one loaded car in the area of a region during the given time (length of transportation);

α - ratio of the run for empty cars to the run for loaded cars within the area of a region during the given time period;

v_h - the average velocity in commercial terms for the travel of freight trains within the area of a region during the given time period.

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The designations (symbols) accepted for the formula: t_o, t_1, and t_n refer to the average quantities for a given period of time and are expressed in hours per 24-hour period; the right side of the equation is divided by 24 thus, in order to express "T" in 24-hour periods.

The successive four parts of the formula represent the average number of hours, which have been expended from the time of a single complete turnover of cars (in loaded and empty condition) at stations and in trains of the region during a given period into the following groups (functions) of cars:

(1) part -- at stations -- into cars being loaded;

(2) part -- in running trains -- into cars loaded or empty which are a component part of these trains;

(3) part -- at stations -- into cars that pass in transit through technical stations;

(4) part -- at stations -- into cars subordinate to dispositional operations.

As can be seen, each of the four parts of the formula has a certain amount of independent significance and meaning which is expressed in terms of a designated part of the average turnover time for one car; there is no reciprocal relationship, therefore, in the formulation of quantities in the individual parts. An analysis of implementation occupies itself in this instance with the causes which determine deviations in time that take place during the execution of car groups designated by the formula from the time that has been planned for these groups.

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The above mentioned formula pictures the special importance of the average stopping time of cars at stations (t_o, t_1 and t_n) to hasten the turnover of cars. This is understandable, because in our conditions a freight car is located in a running train for about 5 hours out of each 24-hour period, the remaining hours during this period are used up with stops at stations. It is necessary to mention that the formulation of quantities t_o, that is the average time at loading places within the region, depends primarily upon the efforts of railroad customers and workers in the commercial service; on the other hand, the quantities t_1 and t_n depend mainly upon the efforts of workers in the traffic service.

Considerable significance is also attached to the average length of the complete course taken by one car in kilometers (K). This quantity may be decreased by shortening the average transportation distance for one ton of freight as a result of economizing in transportation as well as by decreasing the quite large differentiation existing currently between the tariff runs (ton-kilometers) and the exploitation runs (net ton-kilometers). If this economy in transportation depends primarily upon appropriate planning of loads by the shippers, the role of the railroad being limited to control over these plans, then a reduction in the disparity between tariff runs and exploitation runs is a matter exclusively for the railroad to handle and namely the traffic service.

Also the commercial velocity of freight trains (v_h) depends exclusively upon the railroad, i.e., upon the common efforts of several services like the traffic service (appropriate disposition of traffic), the mechanical service (technical efficiency of locomotives), the road service, and electro-technical service (status of the pavement, signal mechanisms, telecommunications).

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A similar analysis is also conducted in relation to the utilization of steam engines (locomotives) and passenger cars. The pertinent analysis is easier insofar as the locomotives and passenger cars are assigned to designated home places and work on designated lines (sectors).

It should be mentioned finally that also the previously mentioned factors of freight car efficiency may be broken down into appropriate parts, the number of which is even larger than during an average time for one freight car. Thus, e.g., the efficiency factor of a freight car may be divided into three functional and reciprocal factors, which represent the following derivative characteristics;

(a) the average distance for one ton of freight;

(b) the average static load for one car;

(c) the reverse of the average time for turnover of one freight car.

It appears from this that the efficiency factor for one freight car is a derivative characteristic that is even more general and many-sided than the average time for the turnover of one freight car.

G. Reporting

A complete, as well as corresponding with the destination, use of rolling stock, i.e., locomotives, passenger cars, and freight cars, is only possible when the railroad administration has at its disposal precise and timely information on the quantity of this rolling stock at all times, its composition, status, utilization, and location.

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The indicated exploitation requirements are the reason why for a long time now an extensive and systematic reporting system has been organized on this subject. This concern for an appropriate utilization of rolling stock is expressed in the numerous service regulations which have established norms in detail to cover the administration individual groups in the rolling stock.

Reporting which pertains to the exploitation of rolling stock on the railroad includes within its subject matter (1) the quantity of locomotives, passenger cars as well as freight cars; (2) the work apart from trains by indicated groups of the rolling stock; and (3) the work in trains.

Reporting on the rolling stock as well as registration of work apart from the trains are conducted

(a) for locomotives -- by the locomotive sheds;

(b) for passenger trains -- by home stations as well as car sheds (locomotive sheds);

(c) for freight trains -- by all stations within the limits established by the "Regulations on the Administration of Freight Cars."

Among the indicated service units belongs also the duty of source material reporting.

Data on the composition, weight, and travel of trains as well as on the runs of rolling stock is registered, on the other hand, by those in charge of trains during the course of work by trains and appears on reporting forms of a prescribed type.

The above indicated two groups of statements differ, therefore, distinctly by the subject of registration and reporting, by the character of the subject being registered, as well as by the technique of registration.

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General information on the reporting on individual groups of rolling stock has already been discussed in preceding sub-chapters. More detailed information on this topic can be found by the reader in the appropriate service regulations which describe the administration of individual groups of rolling stock.

We shall discuss in the following in more detail the matter of reporting in connection with the individual parts of the rolling stock, since they do have close contact with statistical material being collected in this branch of railroad statistics.

1. Quantity and Work of Locomotives

Reporting on this subject is regulated by "Service Regulations concerning the administration of locomotives M No 9," the initial part of which originated in 1920 and has been almost completely changed by later transformations, supplements, and ordinances.

Operational reporting related to the number and work of locomotives apart from trains is based upon the reporting notations by those persons administering locomotive sheds, and namely upon the entry and exit books for steam engines and the work charts. This reporting has assumed the form of reports concerning the "situation for a 24-hour period on the condition of locomotives," presented daily by telephone by the managers of locomotive sheds to RMO. The railroad branches submit similar reports in abstract form from their area to the superior district administration, and the latter to the Ministry of Railroads.

The mentioned reports provide the quantity of disposable locomotives with a grouping into passenger traffic, freight, work apart from trains, under repair, and awaiting repair. In each of

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these groups, reporting data are submitted to further division, e.g., "in freight traffic" for locomotives on freight trains, economic, work, and official trains, in the process of cleaning, as well as free from work; or in the group of work "apart from the train," into steam engines occupied with station maneuvers, maneuvers for other services, and in disinfection, heating, auxiliary work like permanent boilers, in washing, as well as free from work.

The final report by RMO to the district administration and that of the latter to the Ministry of Railroads includes the period of the previous reporting month and is prepared on forms of the type No 621 and 622.

According to the form No 621, we prepare a "report on the status of locomotives" according to a designated date and namely the first day of the month following the reporting month. The number of locomotives is grouped into vertical columns for passenger and freight; each of these groups again according to the number of coupled axles is subdivided. On the horizontal lines, we deduce the number of disposable locomotives by adding to the number of inventory steam engines or else subtracting from them the number of steam engines that have been assigned, ordered off, loaned, or with military authorities. On the other lines, the disposable quantity is grouped according to healthy, in repair, and awaiting repair; and in all of these groups, into further appropriate sub-groupings.

According to form No 622, we prepare a report in the following four separate parts:

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"I. Work and Exploitation of Locomotives." The work of locomotives is expressed in locomotive-kilometers and is grouped into vertical columns for basic work (pulling steam engine as well as coupled locomotive and the pushing type), for supplementary work (loose run, maneuvers or other auxiliary work, reserve), as well as the total; further vertical columns are designated for entry of total numbers of locomotive-hours, steam engine-days, as well as executed gross ton-kilometers; in the final vertical columns we inscribe the computed average quantities, like locomotive-kilometers and steam engine-hours for one active locomotive and per 24-hour period, locomotive-kilometers per one steam engine-hour, and gross ton-kilometers per one active locomotive.

On the horizontal lines the work of steam engines is grouped into the train category (in passenger trains, freight, as well as official, economic and work types) and also apart from trains (maneuvers for traffic service, mechanical service as well as others).

It is notable that in this part of the statement runs of locomotives in locomotive-kilometers as well as the time they are pulling or not pulling other trains is given in gross ton-kilometers, although this is done in total figures without breaking the sums down into individual categories of work.

"II. Quantity and Status of Employing Locomotives (Daily Average)." Numerical data are grouped in this part of the statement within these three following divisions:

(a) the average daily disposable quantity; deduced in a manner that is similar to that provided for form No 621 but in average daily quantities;

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(b) quantity of inactive locomotives with a further grouping into sick, free from work, and in reserve, being washed more than 24 hours, as well as being utilized for substitute work as permanent boilers;

(c) the quantity of active locomotives in trains (passenger, freight, as well as service, economic and work) as well as those occupied with station maneuvers with an indication of service for the requirements of which the maneuvers were implemented.

In the last column of this part of the statement, the percentage ratio of active locomotives to the disposable quantity is given, of course in average daily quantities.

"III. Maintenance of Locomotives." This part of the statement includes data on the number of current repairs implemented, the number of days for stops in current repairs lasting over 24 hours, the number of executed boiler cleanings, etc.

"IV. Status and Utilization of Teams." The content of this part of the statement pertains to the average daily number of locomotive teams as well as the monthly work of one team.

2. Quantity and Utilization of Passenger Cars

According to Service Regulations for the administration of passenger cars No R 28, car sheds (locomotive sheds) in train supply areas submit daily to their DOKP as well as RMO by telephone a dispositional report for the preceding 24-hour period, according to the formula established by the Ministry of Railroads. Depending upon the requirements, the Ministry of Railroads may change or limit the submitted dispositional reports.

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Home stations for passenger cars report daily on the situation of passenger cars.

Apart from the operational reports indicated, car sheds (locomotive sheds) at home on the last day of each month prepare a so-called "Report on the quantity and status of passenger cars M No 13" on forms mentioned in supplement 9 to Service Regulations No R 28 and transmit them to their DOKP and RMO. District administrations prepare abstract reports on these same forms for all car sheds (locomotive sheds) in the district and send them to the Ministry of Railroads prior to the deadline -- the eighth day following the reporting month. These statements are also used in their work by statistical branches in DOKP traffic sections.

The statements consist of the following three separate parts on the title page:

In part I, this is indicated: (1) inventory quantity; (2) number of cars loaned out; (3) number of cars released; and (4) the resulting disposable quantity.

Part II is designated for indicating changes which took place in the quantity of cars during the reporting period. Two vertical columns group within themselves changes concerning (1) an increase in the quantity (cars attached to one's own inventory as well as cars borrowed from other units) and (2) a decrease in inventory (cars transmitted for the inventory of other units as well as released cars). It can be seen in this connection to what series the car belongs and also where the car originated and to whom it has been released.

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Part III groups in vertical columns the total number of cars held on the reporting days and divides these into healthy cars (with a further subdivision into active, reserve, occupied for other purposes, and total) as well as sick cars (under repair and awaiting repair, with a corresponding further breakdown).

On the horizontal lines, we group cars appropriately according to their purpose, i.e., into cars for the transportation of passengers, official and special, baggage and postal-baggage, postal as well as heating.

The reverse side of the statement encompasses the grouping of cars into vertical columns according to 75 series and in horizontal lines on the basis of the same division which has been accepted for the report in Part II as well as in Part III in their vertical columns.

3. Quantity and Work of Freight Cars

In reporting which pertains to the quantity and work (use) of locomotives as well as passenger cars, the development of operational reporting and final reporting is obligatory. This reporting is marked by the fact that

(1) home units preparing the reports are the subjects;

(2) changes over 24-hour periods in the quantity and disposition for these parts of rolling stock are relatively small; this permits final reporting to be limited to monthly periods.

Actual freight cars on the other hand are not and cannot be permanently reported by a designated "home" unit. Depending upon the transportation requirements for freight cars, these are directed in loaded or empty condition to various districts and stations;

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from there again to other stations; etc. These cars frequently leave the PKP network in runs abroad or else enter our network from abroad; these may be cars belonging to foreign railroads. Such a distribution of freight cars which changes rapidly results in

(1) reporting activities delegated to all stations having any connection with these cars;

(2) operational reporting, introduced only as a principle but which simultaneously represents final reporting.

According to Service Regulations on the Administration of Freight Cars No R 2, the two following types of reports are binding with regard to the quantity and work of this part of the rolling stock:

Tabulation of Crossing Cars. Stations bordering upon foreign railroads as well as stations designated as inter-administration dispatching centers conduct a tabulation on the number of freight cars crossing from one side to the other during each 24-hour period.

This tabulation uses as material the data included in the "Specification of Cars in the Composition of a Train" (maintained by the man in charge of the train on form series R No 3), where how many cars have been dispatched in trains for passenger traffic is also considered.

The above indicated stations conduct a tabulation for crossing cars on PKP form series R No 21, and they are obligated to

(1) submit by telephone the final totals for a given 24-hour period being reported upon to their own and to the adjacent RMO; branches after checking the data submit them to the appropriate administrations;

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(2) prepare a telegram on form R No 21a; border stations direct this telegram to their own RMO and to the administration, whereas interadministration stations also send it to the adjacent RMO and to the next administration at the latest within two hours after the completion of a 24-hour reporting period.

The administrations prepare on abstract paper R No 21b the tabulation for crossings during each 24-hour reporting period and establish the total quantity of freight cars in their district for the end of the reporting period. The final totals from the abstract sheet are transmitted by the administrations to the Ministry of Railroads on the day following the reporting deadline, with the use of a cartogram in series R No 21c.

The above mentioned "Tabulation of Freight Cars Passing in the Direction of ... from ... on day ..." (Series R No 21) groups into vertical columns the number of cars classified as covered, coal, platforms, special, tanks, and total; in each of these groups into PKP cars and foreign ones; and in the sub-groups, into loaded and empty cars; on the horizontal lines, data are inscribed according to numbers of trains (for daily computation) or according to the date of the day (for the 10-day computation).

A similar grouping into vertical columns has also been established for the previously indicated telegraphic and cartogram reports; the difference manifests itself only in the grouping of data on horizontal lines.

Report on the Quantity and Work of Freight Cars. Utilizing the statements made by the loading points, tabulations for car crossings, registration of arrived and dispatched cars as well as

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cars excluded from traffic, stations prepare for each 24-hour reporting period and submit on week days to RMO, branches of administrations, and administrations to the Ministry of Railroads a "Report on the Quantity and Work of Cars" for the preceding 24-hour period being reported on.

Transmittal of a report by the station to RMO and by the branches to the administrations takes place on a form in series R No 24b under deadlines established by the individual administration, taking into consideration the local conditions and with such a calculation that the Ministry of Railroads will receive the report from a given administration at the latest within 7 hours after the completion of the 24-hour reporting period.

The administrations prepare and submit to the Ministry of Railroads a report on the quantity and work of cars on a form in series R No 24.

Reports from the day before a holiday and separately for a holiday are submitted on the day following the holiday.

The mentioned "Report on the Work of Cars," Series R, No 24b is a detailed statement numbering 62 vertical columns and including these five following parts:

(a) loaded cars according to their type, i.e., the number of loaded K, W, P, S, R as well as the total; numerical data for each category of cars are inscribed in the form of a fraction $\frac{\text{set in place}}{\text{loaded}}$, whereby separately for cars with four axles;

(b) unloaded cars according to category;

(c) total quantity; it should be indicated how many have been accepted by the station and how many dispatched by it in the form of

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loaded as well as empty cars, how many remained, the work quantity during a reporting 24-hour period;

(d) the quantity of cars excluded from traffic in total as well as broken down:

according to category of car;

on the basis of reasons for exclusion, like repair or awaiting repair; in reserve; occupied for living accomodations and storage space; in work trains, first-aid trains, and "towosy;" sought after and found; on private sidings; being disinfected; etc.

(e) the coefficient of work at a station and the average stop of a car. An even more extensive statement, numbering 107 vertical columns, is the "Report on the Work of Cars," Series R, No 24 prepared by the administrations for the Ministry of Railroads; grouping of numerical data is similar to that indicated above but more extensive; numeration of the appropriate vertical columns in both statements is in agreement.

The stations also prepare a so-called "Report on the Car Situation." By the designation "car situation" is meant the quantity of disposable freight cars and the requirements for these cars, established according to binding regulations at ten o'clock. The disposable quantity of cars (status) at a station is established each day by computing the number of cars on the spot; in this connection we consider only cars with which we can normally cover the requirements. The disposable quantity, therefore, does not include railroad-economic cars, loaded cars, and cars marked for dispatch, cars passing through a station in transit, cars detailed for the reserve, etc.

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On the basis of reports from administrations, the Ministry of Railroads equalizes the situation in cars among all districts by issuing -- depending upon the conditions created -- the appropriate instructions which either limit the setting up of cars for loading or else order the release of empty cars by certain administrations to others. The appropriate regulations are then issued by administrations and by branches.

The report on the car situation, serving actual transportation requirements, differs thus in subject matter from the type of reporting discussed in this sub-chapter.

4. Work of Rolling Stock in Trains

The train work of rolling stock is registered on the spot where the work of the rolling stock occurs and in accordance with the development of this work progressively. The registration is maintained on forms of an established type, designated as

(1) report on trip, series R, No 2;

(2) specification of cars in train composition, series R, No 3 and car specification, series R, No 4, which represent attachments to the report on the trip;

(3) specification on work of the train locomotive, series M, No 31 as well as a specification on the work of a steam engine with double traction and without the train, series M, No 31a.

The enumerated reports on trips and the specifications are not only statements but at the same time documents which should be stored during the period of time indicated by the rules. The manner in which the reports are made by the man in charge of the train and by other executive organs as well as the method of presenting

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them are regulated by the "Instruction on the Maintenance of Reports on Trips, the Attachments to it, and the specification on the Work of the Locomotive, No R 41."

Report on the Trip. Reports on trips are documents which precisely represent the actual picture of work by a locomotive, a train, train teams, as well as all of the circumstances accompanying the movement of a train and the work around it.

The report on the trip includes on its front page approximately seventy vertical columns, collected into the following groups: (a) the locomotive and the steam engine team; (b) workers in the conductors' team; (c) disposition of distribution stations; (d) technical checks and testing of brakes; (e) temperature, weather conditions and results of control over gauges; (f) filling of the train; (g) comments by the train controller; (h) workers travelling to work or from work; (i) issued train equipment; (k) reason for applying double traction or dispatching the locomotive alone.

On the reverse side, (m) data on the trip and train composition; this group includes the following vertical columns: (1) place of train stop (station, halting spot, kilometers, etc); (2) time of travel, of arrival, of stop, of departure, of travel on route, of stop at station; (3) crossing, passing, letting through; (4) completed kilometers; (5) the composition of the train (number of axles); (6) gross weight of train; (7) weight braked, required, actual; (8) issued orders; (9) time of work in maneuvers; (10) reasons for lateness; (11) signature of traffic officer.

On the horizontal lines, we inscribe individually according to completed sectors (see above under first paragraph) all of the data which have been designated for the vertical columns.

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The report on the trip is maintained by the man in charge of the train, but certain of the columns should be filled out and signed by the traffic officer.

After arrival of the train at the station where the trip report is to be completed, the individual in charge of the train hands the traffic officer his report on the trip together with all attachments.

The station transmits the received reports from the trip on the following day to RMO, where they are submitted to control procedure. After completion of these activities, RMO sends the reports on the trip to the administration (traffic section) which, after utilizing them, returns them all to RMO for storage purposes.

Car Specifications (appendixes to trip reports). Cars within the composition of a train undergo description on the spot in sequence as they are arranged; this is done on specification R, No 3, which includes the following vertical columns: (1) the car (mark, number, series); (2) number of axles (loaded, empty, computed); (3) weight (load, total weight of car, actual, braked weight); (4) the dispatching station and destination; (5) abbreviation for administration at goal and number of junction.

The gross weight of a freight car is entered into the specification in whole tons, with a rounding of the last digits below 500 kg, lower; and above 500 kg, higher. The net weight of cars is computed differently for the following cases:

a freight car with passengers	3 t
a car with live animals or fowl	3 t
a collective car	3 t

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a car with partitions, equipment or military baggage	6 t
a car with automobiles, vans, airplanes	4 t

We accept for each car axle the quantity of one ton as load weight (net) in passenger, baggage, postal, and special purpose cars; if these cars are dispatched empty, one need count only their proper weight.

For cars which must be detached at intermediate stations and at sidings along the route, the man in charge of the train prepares a car specification series R, No 4, separately for each place where cars are rearranged. A similar specification is prepared by the station (care station) for cars to be attached to a train at the station or on the route siding. The content of the columns on this specification is related to that indicated previously.

After completion of changes which have taken place in the composition of the train en route at different stations or at route sidings and entering these on specification series R, No 3, the director of the train transfers the final data on the train composition and weight to the appropriate columns on the trip report.

Specification for Locomotive Work. The specification for the work of the steam engine is the basic document for the registration of locomotive work in trains and without trains, train runs, car and axle runs, weight of trains (gross), and of loads (net); it also serves for the registration of work by locomotive teams. In use are two types of specifications for the work of steam engines, indicated at the beginning of this section 4.

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A specification for the work of a train locomotive, series M, No 31, includes on its cover sheet the following columns: (1) for indicating the members of a steam engine team, designating the steam engine, indicating the date and hour of receiving the locomotive, etc; (2) for describing the train (type and number), the beginning and end stations for the locomotive run, hours of departure and arrival; (3) providing the moments (hour) when the locomotive crosses through the control point, leaving it in the steam engine shed, transfer to another team; (4) including data on the category and quantity of coal as well as grease taken.

On the reverse side of the specification, are columns for entering the run of trains, locomotives, cars, gross and net tonnage, train maneuvers, and reserves. The order of the vertical columns is the following: (1) the beginning and end stations for the locomotive run as well as stations for changing the train composition; (2) the number and type of train; (3) the actual trip time as well as stopping time; (4) the locomotive run alone as well as with a train; (5) the number of cars and axles: (a) passenger cars for transportation of passengers, baggage and mail; (b) special purposes; (c) loaded and empty freight cars; (6) weight of the train in tons: (a) net in passenger and freight cars, together; (b) gross in passenger and freight cars, cold locomotives, together; (7) gross ton-kilometers in whole figures for a train and applying to the train locomotive; (8) time of train sidetracking in minutes; (9) reserve in minutes.

On the specification for the work of a locomotive with double traction and without the train, series M, No 31a, there is an absence of columns (1) through (9) described above; it does include,

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however, four groups of columns for inscribing data on the double traction and travel alone, on the train maneuvers and the reserve, and finally on the station maneuvers and other auxiliary work.

Before the departure of a train locomotive from its home steam engine shed, its disposition official hands the engineer two forms of the specification for the train locomotive work; one of these is for the trip "there" and has certain columns already filled out; the other is for the trip "back" and is merely stamped by the home locomotive shed. After attaching the steam engine to the train composition, the engineer hands the work specification sheet to the train director for further maintenance. After arrival of the locomotive to the end station, the train director hands the work specification to the traffic officer for his signature, after which it is given to the engineer. Following the return of the locomotive to the home steam engine shed, the engineer submits the work specifications to the disposition agent for further activity.

A similar method is binding when maintaining the locomotive work specification, series M, No 31a, if the steam engine is occupied on a trip with double traction or alone. For a locomotive on station maneuvers, the appropriate columns in the specification are filled out by the traffic officer as to type, place, and time of work.

Specifications on the work of locomotives, received within a 24-hour period, are sent by the locomotive shed immediately to the RMO which utilizes them to maintain traction statistics, for the computation of work time, and for payments of appropriate compensation to the locomotive teams. At the latest after two 24-hour

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periods have elapsed, RMO transmits the specifications to the administration (branch for statistics in the traffic section) where they are utilized and then sent back to RMO for storage.

H. Organization of Periodic Statistical Research and Statistical Compilations

Periodic statistical observation, pertaining to the quantity and work of rolling stock, take place in the PKP in two stages and include

(a) in the first stage, work executed in a decentralized manner at the district administration level;

(b) in the second stage, abstract work implemented for the entire PKP network by the Central Bureau of Statistics for PKP Transportation (CBS).

The decentralization of work in the first stage and the centralized elaboration of abstract compilations in the second stage require a very efficient and uniformly functioning organization of statistical research. For these reasons Service Regulations No R 37, the so-called "Rules for the Conduct of Labor Statistics in PKP Rolling Stock" which regulate in detail for district administrations the method of collecting material for statistics, the types of this material, the technique of elaboration and statistical tables which are to be worked out. The mentioned rules also include an extensive part entitled "Measurements and Coefficients in Statistics as well as the Method for their Computation" in which it can be established what measurements and coefficients should be utilized for the description and characterization of the quantity and labor of the rolling stock as well as the method for deducing the mentioned quantities.

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In connection with such an organization for periodic statistical research, we will discuss further the following:

(1) statistical material and the method for its collection in the district administrations;

(2) monthly specifications (statistical tables), elaborated by the district administrations;

(3) abstract statistical compilations, worked out for the entire PKP network by the CBS.

It should be mentioned that the organizational unit which works in each district administration on the statistical research of quantity and rolling stock work is the statistical branch in the traffic section.

1. Statistical Material and the Method for Collecting it in District Administrations

Statistical material pertaining to the quantity and work of the rolling stock is collected by the district administrations on the basis of monthly periods.

From the point of view of origin and content, it is possible to distinguish within the collected material the following groups, depending upon whether the matter is in regard to quantity or work of rolling stock:

a. Quantity of Rolling Stock. Statistical material, which in accordance with service regulations should be collected for the establishment of the rolling stock quantity, comprises:

(1) Tabulations of freight car crossings and reports on the size and work of freight cars. This group includes the daily compilation of freight cars crossing, submitted daily in telegram form by the stations under series R, No 21a, as well as reports on

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the quantity and work of freight cars, series R, No 24b, transmitted daily to the administration by exploitation branches in the form of abstract statements from the area of a given RMO. This material includes data for the establishment of an average daily quantity for freight cars during the reporting month, and namely: the general quantity, the quantity of cars excluded from traffic for repair, of cars designated for storage space and living accomodations, as well as cars excluded from traffic due to various causes, cars especially designated for economic and work trains, as well as the working quantity of freight cars.

In the sub-chapter on "Reporting" we discussed that on the basis of such original documents we prepare tabulations on crossings of freight cars and reports on the quantity and work of freight cars.

(2) Specifications submitted by the individual sections in railroad administrations.

The mentioned specifications include the following materials in numbers, compiled on the basis of already discussed reports (see the sub-chapter on "Reporting").

The road section contributes data on the exploitation length of the lines in the district, compiled for each month of reporting (see sub-chapter A. "Introductory Comments");

The traffic section, passenger branch, submits on the tenth day of each month the average daily information about the use of passenger cars during the month being reported on, including:

the total number of passenger cars;

the number of passenger cars removed from traffic for repair;

the number of passenger cars removed from traffic and detailed into the reserve on the basis of a Ministry of Railroads order;

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the number of cars excluded from traffic for other reasons.

The mechanical section transmits by the fifteenth of each month a statement covering the preceding month on the work and average quantity of locomotives assigned to the given district administration.

A report consisting of two parts with titles:

"The Work of Locomotives" as well as "The Quantity and Status of Steam Engine Use (average daily)" takes on the form and content established in appendix 8 to the Service Regulations for maintenance of statistics on the work of PKP rolling stock, No R 37;

The electro-traction section or the appropriate unit in the electro-traction section contributes by the fifteenth of each month a statement for the preceding month on the work and average quantity of electrical locomotives and electrical units in the rolling stock.

b. The Work of the Rolling Stock. Statistical materials refering to the work of rolling stock include:

(1) specifications for the work of steam engines, series M, No 31 and 31a, conducted on the spot of rolling stock work by designated organs of the executive service; the mentioned specifications are, therefore, original documents;

(2) the above indicated under (2) specification of the mechanical section in the part related to the work of locomotives.

The statistical branch in the traffic section receives from RMO the specifications for steam engine work on a current basis, not later than during 5 days from the day these specifications have been submitted by the engineers; the obtained specifications are to be returned after their utilization by RMO by the

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fifteenth of each month for the preceding month. The mentioned exploitation of specifications for the work of locomotives is based on the fact that statistical branches register daily from specifications as a current process on separate forms (R No 145 and 145a) the work done by steam engines and trains;

on lines of one's own administrative area from stations bordering on adjacent administrative districts or else on foreign countries without reference to the owner of the rolling stock and

separately for each other administrative district in which the locomotives of a given administration or steam engines assigned to it have worked.

In such a manner abstract monthly specifications originate on the work of locomotives, trains, and cars completed within the area of one's own area of district administration and within the area of other districts; specifications pertaining to implemented work within the area of other districts, the administrations send to one another reciprocally by the fifteenth of the month, covering the preceding month being reported upon, but retain a copy of the specifications themselves. As a result each administration has at its disposal figures on all the work in its own administrative district.

It appears from the above description that in this area of statistics there is no statistical material collected by the lower executive units exclusively for statistical purposes.

The specifications on the work of locomotives (M No 31 and 31a), daily tabulations on car crossings (R No 21a), as well as reports on the quantity and work of freight cars (R No 24b) serve in the first instance for the requirements of control, administration,

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etc, and finally also the requirements of statistics. The many-sided exploitation of the mentioned statements explains why their compilation and method of transmittal has been regulated so thoroughly and rigorously.

2. Monthly Specifications (Statistical Tables) Prepared by District Administrations

The acquired statistical material is submitted for processing in a manner described in the mentioned Service Regulations, and the obtained results are compiled by the administration by monthly periods into so-called "Monthly Specification on the Work of Rolling Stock on Regular-Gauge DOKP Lines at ... for the month of ... series R, No 148." Specifications should be prepared by the fifth day of the second month following the month being reported upon.

Numerical data concerning the work and quantity of electric locomotives are placed in the appendix to the mentioned Specification R, No 148.

The mentioned "Specification" is essentially a statistical compilation of the work and quantity of rolling stock for a given district and simultaneously a statement for the Ministry of Railroads, incorporating 372 positions; these position are grouped into 25 statistical tables, which are designated by Roman numerals and letters, having the following titles:

table I - Length of railroad lines;

table II - Quantity of passenger cars;*

table III - Quantity of freight cars;*

table IIIA - Quantity of motor cars;*

table IIIB - Quantity of cars with electric traction and locomotives;*

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table IV - Quantity and status of steam engine utilization;*

table V - Loading and acceptance of loaded cars;

table VIA - Run of trains in passenger traffic (train-kilometers);

table VIB - Run of trains in freight traffic, official, economic, and work trains (train-kilometers);

table VIIA - Time of work for trains in passenger traffic (train-hours);

table VIIB - Time of work for trains in freight traffic, official, economic, and work trains (train-hours);

table VIIIA - Run of gross weight in trains (ton-kilometers in thousands);

table VIIIB - Run of net weight (passengers, baggage, loads in trains, ton-kilometers in thousands);

table IXA - Run of cars (car-kilometers);

table IXB - Run of car axles (axle-kilometers)

table XA - Work of own locomotives of the reporting administration (completed locomotive-kilometers as well as gross and net ton-kilometers).

* Only average daily quantity in a month being reported upon.

table XB - Total work of locomotives within a district administration which is reporting (locomotive-kilometers);

table XI - Number of hours for steam engine work (locomotive-hours);

table XII - Average number of axles in passenger trains as well as freight trains - two tables;

table XIII - Average weight of trains gross and of load net in passenger trains as well as freight trains (in tons) - two tables;

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table XIV - Average velocity of passenger trains as well as freight trains (kilometers per hour) - two tables;

table XV - Characteristics of rolling stock work; this includes relative numbers (coefficients) and average quantities, pertaining to

(1) the concentration of traffic (number of train-kilometers and axle-kilometers gross and net per one kilometer of lines being utilized);

(2) work of freight trains (number of train-kilometers and axle-kilometers as well as gross and net ton-kilometers, completed within one hour of work by freight trains);

(3) work of freight trains, and namely

(a) average daily number of cars in the active quantity, cars loaded in the district administration, loaded cars accepted from adjacent administrations and from foreign railroads, unloaded within the district administration, average car turnover counted in 24-hour periods as units;

(b) average weight of load in tons which falls per one loaded car and per one axle of a loaded car;

(c) average tare (proper weight) of one freight car that is active as well as that per one axle of the car;

(d) average gross weight: of one loaded car, together loaded and empty, per one axle of a loaded car as well as per one axle together loaded and empty;

(e) average run of one car in kilometers; loaded (length of transportation) as well as per 24-hour period together loaded and empty;

(f) average time for work of car in trains per 24-hour period (hours);

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(g) ratio of car runs: loaded and empty together with regard to the run of loaded as well as empty to the run of loaded and empty together;

(4) work by locomotives, and namely

(a) the average daily run of all locomotives in passenger trains, freight, official, economic and work trains as well as train steam engines and those attached to all trains;

(b) average daily run by all steam engines in work apart from trains: alone, in train and station maneuvers, in reserve, and total;

(c) the average daily run by all locomotives in total with trains and in work apart from trains;

(d) the ratio between work apart from trains by steam engines and the run of locomotives in trains;

(e) the number of locomotive-kilometers in station and train maneuvers which take place per one loaded car and accepted already loaded;

(f) the average daily run of one active steam engine in trains (with a breakdown into categories of trains), in station maneuvers, total in trains, and in work apart from trains;

(g) the average number of gross and net ton-kilometers completed by one active steam engine in passenger trains, freight as well as official, economic and work trains;

(h) the number of locomotive-hours per one active steam engine daily;

(i) the average run of one active locomotive during one hour;

(j) the average number of train-kilometers per one locomotive-hour in the traffic of passenger trains, freight, official, economic, and work trains as well as total for all trains;

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(k) the number of active locomotives per 100,000 locomotive-kilometers, train-kilometers, and axle-kilometers;

(l) the work of steam engines during station maneuvers: locomotives designated for maneuvers: transferred cars ... as well as consumed locomotive-hours ... per appropriate maneuvers, reserve, total... one steam engine transferred within one locomotive-hour ... cars as well as per one locomotive-kilometer ... cars.

On narrow-gauge railroads the "Monthly Specification of Rolling Stock Work and Financial Results on Narrow-Gauge Railroads, Series R, No 147" corresponds to the described specification series R, No 148; the composition of this specification is completely different, and in this connection the description of quantity and work or the rolling stock is limited to 88 positions.

3. Abstract Statistical Compilations Prepared for the Entire Network by CBS

The already discussed monthly specifications No R 148 are at the same time statistical material on the basis of which CBS prepares centrally abstract compilations in statistics pertaining to the quantity and work of the rolling stock for the entire PKP network. Abstract compilations are prepared by monthly periods, quarters, and years.

These compilations currently include about 40 tables, numbered with figures from I to XIX and also with letters. Tables between I and IV pertain to the average daily quantities of rolling stock, tables from V to XV describe the work of rolling stock, and finally tables between XVI and XIX include data on the average weight of trains in gross and net, the average velocity of trains, and other derivative numerical characteristics.

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It is necessary to mention that certain of the average quantities for the entire PKP network and some of the coefficients must be deduced on the basis of known formulas from the appropriate basic summary figures in these general compilations; the average turnover time for cars on the entire PKP network is not, e.g., the average quantity for the average time of turnover in the administrations.

CHAPTER IV. STATISTICS OF EMPLOYMENT AND WAGES

A. Introductory Remarks

The tasks of building socialism and of developing the national economy, established by the Six-Year-Plan of 1950-1955, require tremendous investments. The main source for these investments is the increase in labor productivity, the tempo of which under conditions of a socialist planned economy should be conducted at its maximum rate. In view of the huge tasks in the Six-Year-Plan, it becomes understandable why we base our new financial organization and the fiscal system in our state enterprises on foundations of economic cost-accounting; it also becomes clear what we mean by demanding the largest planned and above planned accumulation.

State transportation enterprises for public service employ about 40,000 persons. Wages and social security for this huge army of workers comprise over 50% of the total in exploitation expenditures by transportation enterprises. When one considers that expenses for wages for a considerable proportion of workers belong to the category of costs independent or almost independent of quantities shipped, then such matters as the size of the working force in an enterprise, the work time and its utilization, increase

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in the efficiency of labor and the establishment of wages at the appropriate level all come to the fore among the problems connected with a decrease in the high level of exploitation expenditures, with a decrease in own costs per unit, and with an increase in the accumulation of transportation enterprises.

Regardless of this, the status with regard to employment and the wage level among employees in such a large branch of the national economy is of tremendous social significance.

Therefore the most important task of reporting and statistics on employment and wages is the collection and elaboration of material which, in conjunction with the data picturing the implementation of the plan in the remaining branches of the enterprise economy, will permit us to establish the degree and quality of execution regarding planned tasks in labor and wages as well as to conduct an analysis of the causes for established deviations. Such causes may be especially deficiencies in the organization of technological processes, in the system of establishing work norms, in the payments for work, etc.

A systematic reporting system as well as an analysis of statistical material are, therefore, tremendously practical in the fields of employment and wages.

B. Composition and Size of Employment

1. Grouping of Employees

The basic activity of the PKP enterprise comprises the transportation of individuals and commodities as well as forwarding activities. The enterprise executes in addition a series of other

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important activities, the task of which is the servicing and development of fundamental exploitation activities.

In connection with the above, employees working for the PKP enterprise are divided into the following groups:

(1) exploitation group;

(2) extra-exploitation group;

(3) investment group;

(4) group for major overhauling.

The exploitation group includes employees whose work is connected with the basic activity of the enterprise and wages come from the costs of exploitation.

The following belong here:

(1) exploitation employees, i.e., those connected directly with the production of transportation services as well as serving the machines and exploitation equipment;

(2) engineering and technical workers who execute the functions requiring basically the qualifications of an engineer or a technician;

(3) workers in administration and offices, like directors, planners, and economists; workers in cadres' sections, fiscal, administrative, economic, supply and disposal; clerks, telephone operators, etc;

(4) maintenance employees, like yard workers, janitors and messengers, stokers; drivers of automobiles, service unit, etc;

(5) employees in the armed guards, fire prevention service, etc;

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The extra-exploitation group includes:

(1) workers employed in the administration of inhabited houses;

(2) workers on agricultural farms;

(3) workers employed in watching inactive objects belonging to active storage places.

The investment group as well as the group for major overhauling includes workers implementing investments and major repairs from the maintenance aspect and who are paid from investment or repair funds.

The above division in its essence is brought down to a grouping of workers according to the financial sources of their wages.

Railroad transportation works with the aid of many organizational units, spread out over the area of the country according to the line principle. This explains the need for a division of the entire PKP network into district administrations of the state railroads, coordinating the activities of the subordinate territorial units.

The PKP enterprise, in this connection, has a highly complex structure because individual territorial units are made responsible for activities of a designated type. Territorial units designated to implement these same official functions are organized simultaneously and independently of their location into so-called "services." The directing organs in the services are functionally subordinated to a central organ for each vertical chain of command. Such a type of organization is represented by the specifics of transportation, especially by the railroads.

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In this connection, employees of the PKP enterprise belong to different district administrations and simultaneously to various services, like for example to the traffic service, the commercial service, etc.

Official functions of a given "service" comprise several designated tasks, the implementation of which is delegated to the separate work collectives. The work of such collectives is expressed with the assistance of appropriately selected measurements.

Finally within the framework of a designated work collective, the worker may be employed in different positions depending upon his preparation for his profession and the qualifications acquired during a given period.

Such a complex composition of employed workers places a difficult task before employment statistics, especially when the grouping considers still other characteristics like education, official examinations passed, sex, age, type of official relationship, distinctions obtained, etc.

A special statistical investigation may encompass in addition the division of employed personnel according to years of work or seniority. The pertinent grouping takes place usually according to the following characteristics:

(a) total seniority of work (time in professional work);

(b) work seniority in railroad transportation;

(c) seniority of work in a given profession or at a given position while executing the same functions;

(d) work seniority in a given organizational unit (in a work shop).

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The selection of the necessary characteristics is undertaken in concrete circumstances depending upon the purposes of the research.

2. Registering the Number of Employed

In relation to the employees subordinate to personnel reporting in a given labor establishment and receiving wages from it, we maintain an employment specification.

The following groups of employees should be especially included in the specification of employment:

(a) workers who actually reported for work;

(b) workers who were members of official delegations, on rest vacations, health leave, maternal absence, etc;

(c) workers who, despite the obligations to appear at work, did not appear for certain reasons e.g., because of illness, implementation of duty to the state, excused personal reasons, wilfullness, etc;

(d) workers called to serve temporary military duty, providing that they maintain their right to wages;

(e) workers employed apart from the given shop or delegated to take courses, etc, if they receive wages from their workshop.

On the other hand, employment specifications do not include

(a) workers transfered to work in a different workshop and receiving their pay there;

(b) students in higher and vocational schools who are participating in practical work at a given workshop;

(c) workers employed to fulfill short-term work temporarily which does not belong to the framework of basic activity in the workshop, e.g., for minor repairs in the electrical installations, etc.

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The number of workers listed on the employment specification undergoes smaller or greater oscillations under the influence of various causal factors on individual days of the reporting period. There arises thus the necessity for deducing the so-called "average employment," i.e., the average number of workers encompassed by the employment specification during the reporting period.

The average for employment during the reporting period (e.g., in a month) is computed by summing up the number of workers listed on the specification for individual days of work during the reporting period and the subsequent division of the obtained sum by the number of days in the reporting period. In connection with the workers employed in shift work, the average employment is deduced according to calendar days during the reporting period, i.e., also with the incorporation of holidays.

C. Turnover and Fluctuation of Employees

The turnover of employees represents the change in the number of workers due to the acceptance of new ones with the simultaneous release of a certain number of workers, regardless of the cause for their leaving.

Data on the turnover of employees in the pertinent month is obtained from the following columns of forms reporting on labor:

1	2	3	4
Status according to specification on first day of month being reported upon	Accepted for work	Released from work	Status according to specification on first day of month following month being reported on

The sum of the number of employees at the beginning of a reporting month and of the number of workers accepted, after subtracting

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the number of workers released from work, should equal the number of workers on the first day of the month following the month being reported upon (columns 1 + 2 - column 3 = column 4).

Among the number of accepted and released workers, it is necessary to consider only employees accepted for work and released from work beyond the area of a given shop.

The concentration of turnover is expressed by a relative number which represents the turnover of employees, computed according to the following formula:

$$J = \frac{S_o + P}{Z_p},$$

where J - factor of employee turnover;

S_o - status of employment on the first day of the reporting month (column 1);

P - the number of men accepted for work in the reporting month (column 2);

Z_p - the average for employment during the month being reported on.

Releases from work in the above formula find only an indirect expression, namely in the average employment during the reporting month.

The employee turnover expresses the instability of the worker composition as a result of newly accepted employees and releases from work, regardless of the causes for these acceptances and releases.

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Reasons may include, in particular, organizational changes, increase or decrease in the amount of work at a given shop, etc.

As a negative phenomenon, violating and disorganizing the regular course of the production-transportation process, one must treat only those cases when employees left their work due to causes not connected with the functioning of the shop. Such reasons include, e.g., release at one's own request, for violating labor discipline, as a result of incapacity for work, etc. Changeability in the composition of personnel, which is the result of this type of release from work and the subsequent acceptances at work, is designated as fluctuation of employment in contrast to the previously discussed turnover of workers.

Fluctuation of employees may be defined on the basis of a precise investigation of causes for the acceptance and release of workers. If there is a lack of such detailed information, the fluctuation of employees may be computed (with considerable reservations as to accuracy) on the basis of general data on the number of workers accepted or released during a reporting period. The so-called factor of employee fluctuation is namely the percentile ratio of the smaller from among these two figures (workers accepted or released) to the average employment during the month being reported upon.

The above manner for computing the fluctuation factor of employees is justified because only the smaller number (either of accepted or of released) should be considered as the factor causing the fluctuation of personnel in a given instance, whereas the circumstances which have caused the second corresponding number to be not equal but larger should be ascribed to the causes connected with the planned activity of the enterprise.

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D. Time of Work and Its Utilization

1. Time of Work

The time of work is expressed in worked labor-days (also applied is the expression daily work accounted) or in work-hours.

Labor-day is the designation for each day when a worker reports for duty, also including the day of his release from work, independently of the number of hours worked on these days.

The following are included among worked labor-days in this sense:

(a) labor-days of employees who have reported for work at their shop on a given day and have worked a complete or an incomplete day;

(b) labor days worked during days free from work in the form of overtime work;

(c) labor-days while with official delegations on matters concerned with the shop;

(d) labor-days of employees who, in connection with a stoppage of their basic work, have been utilized for other work.

A labor-day does not represent a sufficient measuring device for designating the degree to which work time has been exploited because it does not expose time loss which may occur during the labor-day.

The work-hour is a period of one hour in the course of which the actual work has taken place. Hours of stoppage are included in the labor-days but should not be made a part of the completed work-hours. Hours worked during overtime should be included among work-hours in a regular numerical framework and not by computing according to increased rates of wages paid for these hours.

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Completed work-hours are thus a complete measurement, without any indicated deformities, which serve for the establishment of labor efficiency.

Stoppages indicate the time during which the employee has not worked either at his basic work (due to the stoppage there) and has not been used for any other work. Stoppages may be caused by a lack of materials, electric power, arising damages, etc.

Stoppages lasting a full day are presented in labor-days, shorter stoppages in work-hours.

The time of overtime work designates the hours worked above the legislated norm of labor time as well as the hours worked during days which should be free from work according to the established plan.

The regular length of the work day is designated in Poland by the time of work in industry and commerce. According to the indicated law on labor, it can last at the most 8 hours per 24-hour period and may not be higher than 46 hours per week. The time of work is considered to be the number of hours during which the employee is obligated on the basis of an agreement to remain in the workshop or, outside of it, the number of hours he is at the manager's disposal.

The time of work by individuals in shops subordinate to individual ministries may be regulated, according to the mentioned law, by separate ordinances of the appropriate minister after he hears the opinions of labor unions and thus substituting norms that are equally valid for norms established by legislation.

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Such a separate regulation of labor time required primarily transportation in view of the indispensable continuity of transportation production, the variety of work being implemented in transportation, as well as the uneven concentration of this work even in short time intervals.

An ordinance by the Minister of Railroads on 10 June 1920 had regulated the work time for PKP employees by introducing so-called coefficients of labor, established for each location of work or service unit. The labor coefficients take into consideration the special work conditions in railroad transportation, in the course of which periods of full-value work are divided by periods of waiting for work. The time of service, during which the employee executes his productive occupation actively and without a break, amounts to 46 hours per week; for such work a coefficient of 1 has been established. Service, during which the employee remains in reserve, i.e., remains inactive at the place of service awaiting work, has been designated by the coefficient 1/3. The time for such service should, therefore, be multiplied by one-third to obtain in hours the corresponding time for work of full value. Depending upon the reciprocal relationship of full-value work to the time of waiting for work, the remaining coefficients of labor and the time service lasts have been established. Table 12 includes a compilation of binding coefficients of labor together with the corresponding time service lasts in hours per 24-hour period, per week, and per month, with the assumption that work during a given month takes place in a continuous manner, i.e., also on Sundays and holidays.

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TABLE 12

Labor Coefficient	Ratio of Full-value Labor Time to Time Waiting for Work	Time of Service in Hours		
		Per 24-hour period	Per week	Per month
1	uninterrupted full-value work	6 hours and 40 minutes	46	200
5/6	as 3/4 to 1/4	8	56	240
2/3	as 1/2 to 1/2	10	70	300
1/2	as 1/4 to 3/4	13	91	390
1/3	status of preparedness for work		/138/	

It should be noted that when designating the weekly time of service, it was necessary to accept the number of hours divided by seven which has caused certain minor deviations from the quantities computed by accurate accounting.

The actual length of the labor day during the reporting period is expressed by the average actual time the work has lasted in hours during one day, i.e., taking into consideration the labor time during overtime hours; this quantity is computed by dividing the sum of labor-hours actually worked during a given period by the quantity of actual work-days in this period.

The factor of utilization for the time worked is a relative figure, designating the relationship between the quantity of labor-days actually worked and the total number of labor-days in a given time period.

The total quantity of labor-days in a given time period is computed by multiplying the appropriate average for employment by the number of work days in a given reporting period.

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2. Labor Discipline

During a given reporting period a workshop has at its disposal a designated number of labor-days which represents the product of the average employment and the number of calendar days during a reporting period, decreased by the number of labor-days not utilized in the shop due to absenteeism from work.

Absenteeism from work, always expressed in labor-days, thus characterizes the time unused by a given workshop.

The statistics of labor, when registering days affected by such absenteeism, applies the following classification of reasons for this absenteeism:

(1) vacation leaves of absence;

(2) maternal leaves;

(3) illnesses;

(4) absenteeism based upon other binding legal decisions;

(5) absenteeism with the agreement of the administration;

(6) wilfull absenteeism from work;

(7) days free from work.

Labor-days during which an employee is on an unpaid vacation are counted among those for absenteeism with the agreement of the administration.

The number of days free from work during a period of illness is counted with the days free from work and not among the days of absenteeism as a result of sickness.

With the exception of wilfull absenteeism from work, all the remaining instances of absenteeism from work result from causes accepted by the obligatory legal regulations.

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Labor discipline aims to prevent disorganized work which results from wilfull absenteeism from work, tardiness, and early leaving from work without important reasons.

According to Article 1 of the law dated 19 April 1950 on the guarantee of socialist labor discipline, each employee engaged in physical or intellectual work should be held responsible for violations of labor discipline by unexcused absenteeism.

3. Establishment of Norms

The quantity of employment depends not only on the amount of work which must be completed but also on the degree to which the work time has been exploited.

An acquaintance with data on absenteeism from work, due to various causes, throws only a little light on the problem as to the method by which labor time is being utilized during the labor day.

To define the degree of exploitation of the labor day, it is necessary to establish for each working position how much time is used for:

(a) productive (full-value) work;

(b) unproductive work; as well as

(c) stoppages (waiting for work).

Depending upon the reciprocal relationship among the above labor time components, the number of necessary employees for individual positions in each line executive unit is established within a district administration by a norms commission especially created for this.

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The correct approach to requiring personnel for designated collectives is controlled at the branch and section level with the aid of peculiar measurements as well as factors which define the average amount of work that should be fulfilled by one employee in a given collective unit on the basis of accepted and justified assumptions.

The mentioned measurements and factors are expressed in appropriate units, applicable to the object of work in a given group, as e.g.,:

Traffic Service:

(a) technical control group, number of classification units;

(b) train-shipment group, number of train-kilometers per one employee per year;

(c) maneuvers group, number of transfered cars on an average per day per one employee in the group;

(d) group of cars, turnover in cars at branches and DOKP in an annual relationship;

(e) conductors' group, run of one conductor in terms of conductor-kilometers at an annual ratio;

(f) maintenance group, number of classification units;

(g) administration-office group, number of classification units.

Mechanical Service:

(a) group for technical control in matters of traction, number of active steam engines;

(b) group for locomotive teams, run in locomotive-kilometers;

(c) group for equipping and supplying coal to steam engines, number servicing the locomotives;

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(d) group for inspection of cars, number of axle-kilometers;

(e) group for maintenance of cars, number of axles maintained;

(f) technical control group for maintaining and repairing the rolling stock, number of repair units, where the repair units should make inspections periodically of freight cars;

(g) shop group, number of repair units.

One of the results from this process of making norms for employment is the interest in statistics. The established data represent namely material of considerable importance for the technological organization of production as well as for labor processes which in turn are one of the factors deciding the rate of increase of labor efficiency.

E. Labor Efficiency

1. General Efficiency of Labor

Labor efficiency means the economical utilization of labor and is expressed by the quantity of production at a designated level of quality, produced within a unit of time; or in the reverse, by the time consumed at work to produce a unit of production.

Labor efficiency may be defined as being the

(a) relationship between production and direct work consumed in a given branch of industry, i.e., so-called "live" work;

(b) relationship between production and the total work consumed for this purpose, i.e., "live" work as well as objectivized (materialized) work which is included within consumed production media, used up in the process of production (fuel, raw materials, tools, etc).

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The action of labor competition which has been developing with us on the basis of Soviet movements by Stakhanovites, Luninovites, Krivonosovites, and many others has as its goal the attainment of better production results with a simultaneous more economical consumption of raw materials, fuel, etc, due to which the unit refering to labor efficiency is no longer merely live work.

Most factors in labor efficiency, discussed in this sub-chapter, on the other hand, accept as its unit of reference only "live" work.

An effective solution to a series of economic tasks in railroad transportation, and primarily the necessity for the largest possible accumulation, requires a considerable and systematic (i.e., one lasting from year) growth in labor efficiency.

Since compensation for work in railroad transportation represents approximately 50% of the exploitation expenditure, an increase in labor efficiency becomes one of the main factors conditioning the reduction of one's own unit costs.

An increase in labor efficiency also makes possible the implementation of larger shipments with the same member or else only slightly more employees and quantity of rolling stock. Thus the income of an enterprise is increased more than the exploitation expenses, whereas accumulation grows at a much livelier rate.

A further important problem in the organization of wages mainly depends on an appropriate connection between the size of wage earnings and labor efficiency.

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In any branch of production which manufactures the same kind of products, the best and most convenient measurement for expressing labor efficiency is the number of completed products which occur per one employee during the reporting period.

The monetary measurement (in current prices or in unchangeable prices) must be used in instances where various types of products are being manufactured and when the use of physical units, units of weight or measurement or else other similar units (pieces, meters, ton, etc) is impossible.

Transportation activity is expressed basically by two measurements, i.e., in ton-kilometers and passenger-kilometers.

It is, therefore, understandable that to obtain a general designation for labor efficiency both the indicated measurements are frequently consolidated in transportation into only one physical measurement -- usually the ton-kilometer.

The average labor efficiency in transportation is measured especially by the number of ton-kilometers originating from the shipment of consignments (also economic and official) as well as from the appropriate computation of passenger-kilometers into ton-kilometers and which in a given time period are expressed per one employee working in an exploitation group.

The relative unit in the above formulation is the unit of work, i.e., the time of work of one employee; for computations, however, we accept depending upon requirements (a) labor-hours, (b) labor-days, (c) months, quarters, years.

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The possibility of using just one physical measurement in computations, i.e., the ton-kilometer, guarantees conditions for a direct comparison between various transportation media from the point of view of labor efficiency.

In the USSR the measurement of transportation production accepted for this purpose in all transportation media is the ton-kilometer. In railroad transportation, the Russians apply so-called comparative (substitute) ton-kilometers which are computed according to the assumption that one passenger-kilometer equals one ton-kilometer. Such a comparison is justified by the circumstance that one's own cost for one passenger-kilometer on USSR railroads is only slightly higher from own cost for one ton-kilometer.

On the PKP the self-cost per one passenger-kilometer in 1924 was almost equal to the cost for one ton-kilometer, whereas in 1939 it was twice as high, and currently is about 25% lower.

Due to this constantly changing relationship between own cost of the passenger-kilometer and the ton-kilometer, the PKP accepted as the basis for designating general labor efficiency the gross ton-kilometer. This method has considerable conveniences, since there is only one physical measurement here, thanks to which further computation is unnecessary; gross ton-kilometers simultaneously take into consideration the transportation of empty rolling stock.

It should not be forgotten, however, that gross ton-kilometers include not only the gross transportation production but also the work connected with the establishment of this production. The acceptance also of labor, and not exclusively of net production, as the basis for designating labor efficiency is contrary to the essence of what we understand by the term labor efficiency

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and leads us to the wrong conclusions; the establishment of even a smaller quantity of net transportation production with a poorer utilization of the rolling stock, and thus with an increase in the number of gross ton-kilometers, will be designated by such a method for computation as an increase in labor productivity which is obviously incorrect.

The acceptance by the PKP of a method for designating labor efficiency which differs from other transportation media has also precipitated considerable difficulty in comparing directly various media of transportation on the basis of accomplished achievements.

For the above reasons the PKP has introduced since 1 January 1952 a designation of labor efficiency also on the basis of substitute ton-kilometers.

Designation of labor efficiency in railroad transportation on the basis of shipping production may be applied only as the most generalized characteristics of the exploitation group for the entire railroad network and not in individual districts.

In implementing the individual shipments usually two or more district administrations participate, and they work as a rule under differing shipping-traffic conditions. Certain of these districts namely have a transit character which is expressed by many completed runs. In other districts the type of work connected with dispatching or accepting passengers and consignments predominates, whereas the number of completed runs is relatively smaller.

It is known from the economics of transportation that when the number of shipments increases, the number of workers employed

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in the exploitation group does not increase in direct proportion but does so at a much slower rate. When shipments decrease, the number of employees drops much more slowly than the number of shipments. The incommensurability between the quantity of transportation and the number of employed workers -- under identical otherwise conditions of work -- influences considerably the formulation of the value for the labor efficiency factor, which should be noted when comparatively evaluating the level of labor efficiency during different time periods.

2. Labor Efficiency in Individual Services and Groups

The general labor efficiency in railroad transportation, expressed in ton-kilometers gross or in substitute ton-kilometers, is characteristic for the entire exploitation group on the whole railroad network.

Such a general characterization is insufficient for the needs of a planned economy in railroad transportation and requires supplementary information as to how labor efficiency looks in various functional and territorial cross-sections for railroad transportation, i.e., in the individual services and work groups on the entire railroad network or on parts of this network.

Labor efficiency attained in individual services as well as work groups is expressed in units designating the direct object of work (production) for a given service or a given group, namely in the same units which enter into the composition of peculiar measurements as well as factors discussed more closely in connection with the establishment of norms for the quantity of employment in sub-chapter D.

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The described characterization is not necessary for purposes that can be classified as being operational; as a result the factors of labor efficiency are designated for longer reporting periods, at least quarters.

3. Analysis of Labor Efficiency

The formulation of the labor efficiency level is influenced by various factors which should be considered when planning labor efficiency and when analyzing the results. Among the more important factors are the following:

(1) social factors:

a. increase in the political and social consciousness of the workers under conditions of the socialist system;

b. raising the cultural-technical level of employees;

c. socialist competition in labor, the stakhanovite movement, rationalization, etc;

(2) factors of nature:

a. influence of geographic conditions, deciding the number of employed workers (in railroad transportation, e.g., difficult profiles on the road, drops and rises, etc);

b. influence of climatic conditions;

(3) technical factors:

a. new technical equipment and the improvement of existing equipment;

b. mechanization of labor-consuming work;

(4) total quantity of production, and especially production quantity of the same category;

(5) organizational factors:

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a. supplying under deadlines with raw materials, fuel, and other materiel;

b. organization of technological processes and increase in the participation of work that has had norms established for it;

c. preparation of cadres, continuous instruction of employees, and raising their qualifications;

d. an appropriate organization of wages;

e. planning of work and transportation (especially their uniformity as well as control over planned task implementation);

f. practical application of experience by shock workers;

g. improvement in labor discipline and the prevention of fluidity in the working force;

h. improvement in working conditions as well as improvement in labor safety and hygiene.

In the series of factors with an organizational nature which influence the increase of labor productivity, one of the most fundamental is a well based classification of personnel.

This should be established primarily upon the making of work norms, designating either the time necessary in work for accomplishing individual functions or else the quantity of production units which the worker should manufacture during a unit of time; in both situations, under conditions of full utilization of the working day as well as the technical equipment and other production media.

A rational norm setting process should not be directed toward maintaining current norms as average statistical values (i.e., based upon results previously achieved) but should strive toward the attainment of average-progressive norms based on the results

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obtained by shock workers; their experience, methods, and results should find the broadest practical application in this manner and become the basis for reconstructing the technological process.

Because of the tremendous importance attached to the increase in labor efficiency by the economics of railroad transportation and because of the connection between labor efficiency and the level of wages (piece-work payments), whether by the quantitative method or on the basis of quality, the PKP enterprise must direct its efforts toward raising labor efficiency and weaken or eliminate completely the influence of hinderances as well as appropriately activize and develop the influence of factors favoring and awakening this movement.

Analysis aims to use materials transmitted by operational and statistical reporting for uncovering the degree to which obtained results correspond to the efforts and planned tasks in this direction.

It should be mentioned that an isolated factor designating the efficiency of labor for a given reporting period is a quantity that tells us relatively little since it does not express the dynamics of labor efficiency. Statistical compilations on this point should, therefore, for purposes of analysis, include data on labor efficiency over several reporting periods which belong especially to the same multi-year economic plan. These data should be compiled in numbers that are not relative, and also for a stronger contrast in the picture with relative numbers expressed in percentage or in dynamic factors (indexes).

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As an example of this type of statistical compilation, a part of the table appearing in the work of W. Umblia entitled Osnovy Organizatsi Normirovania i Planirovania Truda na Zheldorozhnom Transportie, Moscow, 1949 (a Polish translation was recently issued by the Communications Publishing House in Warsaw) may be used. This table illustrates the factors of labor efficiency and of employee utilization on USSR railroads during the years, 1935-1940:

TABLE 13

Numbers	Factors	Measurement Units	1935	1936	1937	1938	1939	1940
1	In transportation measurements per one employee	thousands of ton-kilometers	273	340.2	370.7	366.9	384.0	397.2
	In percentage per results of 1935	-	100	124.6	135.8	134.4	140.6	145.5
2	Locomotive teams: (a) monthly efficiency of one engineer in freight traffic during obligatory work time	kilometers	1798	2074	2264	2235	2233	2384
	In percentage per results of 1935	-	100	115.4	125.9	124.3	124.3	132.6
	(b) number of ton-kilometers per one team member	millions of ton-kilometers	2.8	3.4	3.8	3.9	3.9	4.2
	In percentage per results of 1935	-	100	121.4	135.7	139,3	139.3	150.0
	(c) average team composition	individuals	2.72	-	-	2.86	2.89	2.9
	In percentage per results of 1935	-	100	-	-	105.1	106.3	106.6

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F. Wages

1. Systems of Payment

An increase in wages should be connected closely with the increase of labor efficiency; in this connection

(a) the increase in labor efficiency must take precedence in time over the increase in wages, representing the latter's reason and basis;

(b) the increase in labor efficiency should not be equalized by an increase in wages so far reaching that it would be unjust as well as contrary to the requirements of socialist accumulation, representing the material basis for a broadened reproduction.

An appropriate organization of wages is on its part one of the most important elements awakening an increase in labor efficiency. The lack of wage organization, on the other hand, not only influences labor efficiency negatively but may become the cause for another negative phenomenon, i.e., an increased fluctuation of employees.

The existing wage systems are based upon the establishment of wage payments either in relationship to the amount of completed production or in relationship to the amount of time worked.

Among the four fundamental payment systems applied -- i.e., the regular piece-work, progressive piece-work, regular daily wage, and premium daily wage -- only the system of the regular daily wage is constructively connected with an increase in labor efficiency.

The above indicated wage systems are founded on the following principles:

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(1) in the regular piece-work system, work is paid for in ratio to the amount of created production; the wage paid for a unit of created production does not change, therefore, depending upon whether and to what degree a worker has completed an established work norm;

(2) in the progressive piece-work system, the employee who goes above the established work norms receives compensation which is computed on the basis of a differentiated method, and namely:

(a) a part of the production created within the binding limits of the production norm is paid according to the regular table of wages;

(b) the further part of the created production, above the binding production norm, is paid according to an increased scale of wages;

(3) in the system of the regular daily wage (time), compensation earned is computed according to a table of payments; in this connection, the quantitative or quantitative factors of completed work do not find expression in wages; this system represents the computation of payments for the time worked and should be applied only to employees whose work cannot be calculated accurately enough nor subordinated to norms;

(4) in the daily premium wage (time) system, the worker is paid a definite daily compensation (for time) and also receives, besides the rate computed according to a table of rates, a premium for the completion and overfulfillment of the plan as well as for the attainment of designated qualitative labor factors (e.g., for saving fuel and greases, materials, for more runs between repairs, etc); this system is mainly applied to workers in the intellectual categories and to certain vocational groups.

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The regular piece-work as well as the progressive piece-work systems of payment may take on the form of either an individual or a group system.

In the individual system the wages of each employee are computed depending upon the quantity of his individual production. The individual system represents the most widely used and mass applied type of wages. In the group system payments are computed on the basis of production by the entire group, and the division of compensation among the group's individual members takes place depending on the time worked by each employee and upon his personal position and classification according to the table of payments. The group system is less frequently used as a method of payment.

In the PKP enterprise, the following two basic systems of compensation are applied:

(a) the piece-work system;

(b) the system of the daily wage as well as the monthly salary, connected with the payment of premiums, the size of which depends on the degree of labor efficiency.

The special labor conditions in railroad transportation have caused that, besides basic wages designated by a given system of payments, workers employed in the PKP enterprise receive so-called supplementary wages and extra payments which we shall discuss more fully in connection with the description of the wage fund composition.

2. The Wage Fund

The wage fund during a monthly reporting period encompasses all types of compensation paid to employees on the basis of their relationship to work during a given month, and especially the basic

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wages with extra payments as well as supplementary compensation. The wage fund does not, on the other hand, include other expenditures, e.g., on the basis of reimbursement for the costs of trips, official delegations (per diem), awards, etc.

The wage fund for commercial and service units differentiates among two categories of workers, and namely:

(a) administrative, whose wages do not precisely depend on the degree of fulfilling planned functions;

(b) operational workers, whose work is precisely connected with implementing planned functions of an enterprise and whose wages depend on the degree to which these functions are executed.

The final accounting, which regulates total wages for all categories of employees during a given month, should be completed by the fifteenth of the month following the month in which an enterprise has made payments.

The wage fund for a designated month includes, however, also payments made during a later period, providing merely that they pertain to compensation on the basis of relationship to work for a given month being reported upon. For this reason all later wages with regard to the month already accounted may be executed only if they occur within the limits of an unexhausted wage fund for the month which they pertain to.

The wage fund also includes compensation in full ("gross"), i.e., without taking into consideration deductions for taxes or other reasons.

The final accounting and report, concerning the wage fund for the individual reporting period, include data on the formulation of

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the wage level which depends upon the quantity of transportation services produced. These data facilitate an answer to the following questions:

(a) How has the average wage of employees in administrative work formulated itself?

(b) How has the wage fund for operational employees formulated itself in relationship to the quantity of executed functions?

(c) What is the relationship between the percentage of fulfilled services that have been planned per one operational employee and the percentage of deviation by the average earnings of these workers from the wages foreseen by the wage fund.

3. Subject Matter of Wage Statistics

Wage statistics is engaged in statistical investigations of the relationship existing between changes at the wage level and the increase in labor productivity. In this connection the research may pertain either to a designated branch of the national economy or to individual divisions of a given branch or separate vocational groups of workers.

The relationship between the increase in labor efficiency and the wage level manifests itself in the formulation of wage earning composition, the level of wages in different vocational groups, the degree to which various wage systems have been disseminated, etc.

In this connection, the program for statistical investigation of wages encompasses the following subject matter:

(1) composition of the wage fund; it is necessary here to characterize the individual component parts of the total wage fund.

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In statistical reporting by PKP enterprises, this wage fund composition includes the following elements:

A. Basic wages:

(1) basic pay, like:

(a) piece-work pay;

(b) payment by the day;

(c) monthly salary as well as supplements: equalization, local, functional and service;

(2) additional payments:

(a) premiums;

(b) supplements of 50% and 100% on the basis of overtime hours;

(c) extra for night duty;

(d) extra for harmful and difficult working conditions;

(e) payments for stoppages;

and others.

B. Supplementary wages:

(a) payment for unworked hours by young practice-students;
(b) wages for interruptions in work for nursing mothers;
(c) compensation for absence connected with execution of social and state functions;

(d) payment for rest vacation and occasional leave;

(e) advances when released from work;

(f) cost of fuel allowance;

(g) value of free service depositions (official living quarters, fuel, electricity);

(h) value of free uniforms;

(i) compensation for sick leave and for time spent on military maneuvers.

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A separate position is occupied by the "anonymous wage fund" which consists of:

(a) compensation for all on the spot work (e.g., unloading);

(b) compensation for detailed work and for participation in meetings of commissions.

On the other hand, the wage fund does not include (which are counted as social payments) obligations such as:

(a) compensation for work during vacations;

(b) awards;

(c) per diem for travel;

(d) return of moving expenditures when officially transferred;

(e) compensation for improvements and inventions;

(f) annuities and retirement;

(g) compensation for funeral expenses, etc.

(2) The average wage during the reporting period; to obtain the appropriate numerical characteristics, a grouping of workers and employees is conducted according to the quantity represented by the average earned wages in gross (without deductions) which are due them, in each group according to the individual systems for compensating employees. Thus one obtains data on the size and percentage participation in these groups of employees who are paid according to various wage systems as well as on still other factors in the structure.

Grouping according to the quantity of the average earned wages should also include workers and employees who have figured without any interruption on the employment specification for a given reporting period. It is not necessary, therefore, to provide a grouping of workers and employees who during the reporting

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period were accepted for work, released from work, or were sick; if this were done, we would obtain distorted data.

(3) The degree to which various wage systems are utilized; to obtain the pertinent data, we apply three methods, each of which has its own designated meaning.

The first method is used for establishing -- by means of an appropriate grouping -- the number of work-hours completed during a reporting period according to various wage systems. Among the number of persons employed at work compensated for according to the progressive piece-work system, one must include all workers paid on the basis of this system and also those who have not overfulfilled their work norm during the reporting period assuring that the higher wage scale be applied.

The second method consists of establishing a wage system by grouping workers (included on the employment specification) according to the wage system applied to the work assigned them.

The third method is used for investigating individual components in the wage fund, i.e., for the establishment of factors characterizing the composition of the wage fund which has already been discussed under point 1.

The tasks of analysis, conducted on the basis of materials submitted by the reporting system and wage statistics, include:

(1) exposing deficiencies and weaknesses resulting from the application of various wage systems;

(2) uncovering incommensurabilities between the wages for individual vocational groups;

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(3) establishment of the proper remedial media for the elimination of exposed improprieties, deficiencies, etc.

G. Reporting

Subsequently we shall discuss the extensive monthly reports on the employment status as well as the load placed on personnel during the reporting month. These statements are prepared by hand; they should be included with statistical compilations because of the systematized groupings of collective units according to designated characteristics, taking into consideration the requirements of analysis.

a. Compilations of Employment Status

The basic statement, which informs us of the changes taking place in the employment quantity during a reporting month, is the "compilation on the status of employment for workers in the PKP enterprise."

On the basis of material received from the individual branches, administrative sections prepare statements for their subordinate services; the mentioned statements are the basis for elaborating the abstract compilation for the entire administrative district.

An abstract compilation is prepared according to groups of employees (exploitation, extra-exploitation, investment, and major repairs), within the framework of groups according to regular and narrow-gauge railroads; for regular gauge railroads, on the other hand, according to services. On the horizontal level, employees are grouped on the compilation into physical and intellectual; in the major repair and investment groups, into physical, engineering-technical, and administrative workers.

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The statement includes the following more important data:

(1) the status of employment during the month preceding the reporting month;

(2) columns "arrived" and "departed" with a specification of reasons for traffic;

(3) status of employment during the last day of the month being reported upon, according to the accepted compilation of employed groupings;

(4) data on the size of employment in the quarterly plan for comparison with the actual employment status;

(5) number of work-hours (regular as well as overtime) worked effectively;

(6) number of labor-hours not worked effectively during the reporting month with a grouping according to the type of causation;

(7) number of executed work units as well as attained labor efficiency; data in this column are only inscribed in compilations for the last month of a given quarterly period.

b. Report on Loads Placed Upon Personnel

The monthly statements on the loads placed upon personnel in the service division of the PKP enterprise comprise two parts which include:

(1) loads placed on personnel during the reporting month, i.e., upon the individual elements of the wage fund; the loads are contrasted in the statements with the planned level of the wage fund for the quarterly plan, expenditures for uniforms, and the fuel ration;

(2) loads placed on the anonymous wage fund as well as payments and also other personal loads; the loads are contrasted with the level of the planned anonymous wage fund, deductions, and awards in the quarterly plan.

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The mentioned statements are prepared by:

(1) sections of the state railroads and by equal units in the form of unit statements, separately for each service according to fiscal groups; the basis for preparing reports are the compilations of payment lists;

(2) sections of district administrations in the form of a summary for a designated service; the basis for preparing these statements are the reports of units obtained from units subordinate to the administrations; reports by these sections carry the designation of basic;

(3) district administrations in the form of abstract statements for the whole district, with a grouping according to regular and narrow gauge railroads, next according to fiscal groups, and in the exploitation group according to services.

The statements of sections and the abstract reports of the administrations are checked as to the level of global loads with the final notations on a given analytical account in the offices for DOKP bookkeeping.

CHAPTER V. STATISTICS OF MATERIALS

A. Tasks of the Materiel Economy

The basic task in a materiel economy is the continuous supply of the production process with the required productive media in order to guarantee production continuity.

By productive media we mean labor media and labor objects. The labor media will be discussed in some detail under the subchapter entitled "Statistics of Permanent Media;" labor objects include raw materials (i.e., products of the extraction industry and agriculture), materiel (i.e., products of the manufacturing industry), and fuels.

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The mentioned productive media, submitted to the activity of labor during the production process, provide as a result the intended production. A considerable part of this production represents new productive media, which in turn have been directed toward a further productive and reproductive process.

During the process of materiel supply, there is thus manifested a close connection and a reciprocal relationship between the individual enterprises and the branches of the national economy. The supplying of certain enterprises with necessary productive media simultaneously represents the disposal of prepared production for other enterprises which produce the given media.

Productive media are subordinated by this method to the turnover process, whose cycle is composed basically of the following stages:

(a) supplying production with the necessary productive media;

(b) the production process;

(c) realization, i.e., disposal of prepared production.

The supply of materiel and its disposal are thus the two border moments, designating the turnover cycle of productive media in their movement from the producer to the consumer.

On the scale of our national economy the supply of materials and, to the degree that production is fulfilled, the disposal of its production are represented as a single process which guarantees the material conditions for a simple and broadened reproduction. An organized transfer of production from the producer to the consumer insures the implementation (disposal) continuity for the completed production as well as an unbroken and scheduled supplying of enterprises with the necessary production media.

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Under conditions of a socialist economy the reciprocal relationships described which take place in the materials' supply process cannot develop in a lively manner but become the object of planned interaction. The plan designates the forms and the content of materiel supply as well as establishes the most appropriate direction for the utilization of materiel supplies.

The process of turnover for productive media occurs differently in transportation. Thus in transportation it is not possible to isolate the implementation of transportation implementation from the production-transportation process. As a result of such a state of affairs the turnover process for production media includes only these two stages in transportation:

(a) supplying of transportation with the necessary productive media;

(b) the production-transportation process, being simultaneously a disposal of produced transportation services in favor of the service-consumers.

To understand the considerable significance attached to the materials' economy by the PKP enterprise, it is sufficient to indicate that of the total sum of costs for this service branch together with expenditures for major repairs executed economically, the percentage participation of costs connected with the consumption of materials in the years 1948 and 1949 was above 25%.

With such a quality weight for materiel supply, our attention must be focused so that the materiel' economy should correspond to the requirements of purpose and rationality in savings, especially:

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(a) to guarantee a permanent and economical access by necessary materials in appropriate, at advance designated schedules, quantities and qualities;

(b) to guarantee against the freezing of turnover media by establishing surplus or completely unnecessary supplies;

(c) to secure a rational consumption of materials by consumers.

The above indicated tasks should be implemented through:

(a) an appropriate elaboration of a plan for materiel supply which would harmonize with the part of the transportation-financial plan. The supply plan should be especially compiled on the basis of an accurate establishment by the place of work (i.e., by the future consumers of the materials) of a detailed plan for the consumption of materials, fuel, and certain equipment necessary for the execution of planned transportation tasks, for current repairs as well as major ones implemented by economical means. The plan for the consumption of materials should be based in this connection upon progressive and mobilizing norms for the usage of materials, elaborated with consideration of rational savings;

(b) the establishment of quantities for storage supplies on the basis of the production plan and schedules for delivery as well as a precise designation of alarm statuses with reference to the individual assortments of material;

(c) watching the process of materiel consumption as well as analyzing, controlling, and correcting accepted norms for consumption which represent the bases of the plan for materiel usage and furthermore also for the supply plan.

The above basic tasks for a rational economy of materials and the methods for their implementation also designate the subject

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matter for materiel statistics. The given subject matter comprises namely:

(1) supply in materials;

(2) supply and turnover in materials in storage (warehouses);

(3) consumption of materials.

As a source material, the statistics of materiel utilizes data from reporting, accounting, and statements concerning materiel.

B. Supply of Materials

1. Grouping of Materials According to a Category Composition as well as a Materiel Terminology

Corresponding with the requirements of the plan for materiel supply and the fiscal plan, the following grouping of materials is binding according to the category composition:

(1) basic materials;

(2) auxiliary materials: (a) direct; (b) indirect;

(3) fuel;

(4) packing material for consignments;

(5) inventory of little value and short duration;

(6) spare parts for machinery and technical equipment;

(7) merchandise.

Basic materials (raw materials, products, and semi-manufactured items) are the objects of work which represent the basic substance in production since they

(a) either enter into the composition of the manufactured product, representing its component part (e.g., clay for making bricks);

(b) or else are subordinated to change in the production process, providing as a result new products (e.g., iron ore for the production of cast iron);

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(c) or represent the packing which is an inseparable part of the product in the form as destined for disposal and which is computed as part of the sales price (e.g., match boxes).

Direct auxiliary materials are those materials being consumed directly in the production process, in the course of which these materials do not represent an essential component part of the new product but give it only its properties and in the process provide it with certain positive characteristics (e.g., dyes, varnish, enamel, etc).

Auxiliary and indirect materials are those which

(a) do not enter into the composition of the manufactured product and do not provide it with their characteristics; on the other hand, their consumption is connected with the production process (e.g., materials that rub off, grind, veneer, etc);

(b) or serve only for conservation and maintenance of production equipment in movement;

(c) or else serve for general administrative-economic purposes.

The division of materials into basic and auxiliary depends upon their role in the manufacture of given products. These same types of raw materials and others may be considered as basic and auxiliary, depending upon the function they fulfill in the manufacturing process. For example, sand for grinding purposes is an auxiliary material, but sand for cement products is a basic material; similarly coal for heating or creating energy is a fuel, on the other hand in coking plants coal represents a basic material.

The inventory of little value and short duration encompasses the objects which do not use themselves up immediately, indirectly

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or directly, in the production process; however due to their small value or limited usage time they are not counted among permanent media. The following belong here, for example: working tools, appliances and measuring equipment, minor office inventory, the store house, economic, etc, as well as protective clothing.

The above grouping of materials according to category composition manifests certain deficiencies; this grouping, since it is being conducted primarily from the viewpoint of requirements by enterprises manufacturing material objects and is only slightly appropriate for transportation enterprises. Transportation enterprises belong to the service-production type and thus do not consume basic materials in the exploitation division.

Until this state of affairs is changed, the PKP uses temporarily, especially for planning purposes, the division corresponding to the composition of materiel groups in the Branch Plan of Accounts for the service part of PKP enterprises. The mentioned BPK groups materials in chapter XI as follows:

(1) auxiliary materials; included are all materials encompassed by the terminology of materials utilized for requirements of production activity, administration, etc (account 125);

(2) fuel; this group includes fuel for technological, power, and economic purposes (126);

(3) spare parts for machinery and equipment; included here are spare parts for railroad rolling stock, automobiles, machinery, and technical equipment designated to replace used parts (127);

(4) nonpermanent objects; included here are objects which, due to their small value (according to criteria binding in 1953, less than 300 zlotys) or because of the limited time they can be used (under one year) cannot be included among permanent media;

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nonpermanent objects are for instance tools, protective clothing, minor office and storage house inventory, consignment packing for return, etc (128);

(5) packing materials; reference here is to wrappings sold by the producer together with the merchandise; thus packing materials included among permanent media or packing which should be returned to the producer (132) do not belong here;

(6) scraps arising in the course of technological processes as well as materials which have completely lost their original utilization value as a result of destruction or damage (135);

(7) nonindustrial supplies; these are materials (merchandise) of foreign production, designated for consumption apart from the framework of basic production; e.g., for agricultural purposes, housing, etc (137);

(8) live inventory; animals included among turnover media belong here, as e.g., dogs or other young animals while they are being raised; the latter after attaining an appropriate age and physical development will be counted either with permanent media or for sale (138);

The above groupings consider above all the needs of fiscal accounting from the point of view of materiel economy. The use of this division, however, also possesses certain practical positive sides. These will be discussed in the section on reports on materiel turnover.

The tremendous variety in production media results, for the requirements of a rational materials economy, that they must be encompassed in a specification which includes the names of individual types of raw materials, materiel, fuel as well as equipment and tools with a division into groups according to designated characteristics.

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Such a type of technical terminology should meet the following requirements:

(1) the names of individual types of raw materials, materials, fuel and equipment as well as their classification on the specification should be uniform and standardized for all enterprises and organizations interested in production, supply, and the consumption of the given materials;

(2) the specification of productive media should be prepared in an expert manner technically, corresponding in type, category, or some other qualitative differentiation for the given kind of production and should correspond to the established norms.

The basis for constructing such a specification is usually accepted in the form of a statement of products according to category of materials; e.g., ferrous metals (iron), nonferrous metals, wooden materials, construction materials, etc.

The conditions for such uniform specifications for individual categories of raw materials, fuel, and equipment correspond largely to the specifications accepted in balance sheets and plans for a division into individual types of production which have been approved by the government. These specifications are prepared according to collective positions and are identical for all enterprises and organizations which produce and use the given products manufactured. There are no obstacles in the way of further precision in terminology within the framework of this general specification or of extending it by the introduction of supplementary names designating a more detailed type, quality, quantity, etc. The necessity for such supplements results from the special properties in the production and supply of individual enterprises with regard to the specific character of their work.

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The names in the specification should be listed in an appropriate order and classified according to groups and sub-groups, types, qualities, dimensions, or other qualitative characteristics.

To shorten the designation of individual names for products, we accept in the specification for each group, sub-group, type, quality, etc designated symbols, i.e., agreed upon numerical designations.

Recognizing the importance of the foregoing problem, a special commission attached to the Main Statistical Office worked out an introductory project for a complete "Uniform Specification of Commodities" which embraced a classification of all commodities without regard as to industrial, agricultural or other origin and whether produced domestically or coming from imports. The publication of the above "Uniform Specification of Commodities" was to be printed in 1953.

It is also necessary to mention here that in storage house reports a division of materials into new and old-usable also occurs.

2. Reporting on Delivery

The delivery of materials is preceded by several formal acts (functions), taken up within the framework of the plan for materiel supply in order to precipitate the delivery of materials in designated quantities, of the required quality, and on a determined schedule.

Such formal acts (functions) include the following: materiel requirements and obtaining an allotment, ordering, small purchases, entering into an agreement for delivery of materials, etc.

Reporting in the area of materiel supply encompasses the above mentioned acts (functions) as well as data on materials arriving as a result of implementing these acts.

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Registration of these data may be conducted effectively with card files which have been divided into introductory categories for the acts (functions), i.e., into requirements, orders, small purchases, agreements effectuated for delivery of materials, etc.

Within the area of each of these divisions, the card file should be conducted (divided) according to established terminology for the materials to be supplied.

Each card in the file includes at the beginning columns for the inscription of data, designating more closely the introductory act like the number and date of the pertinent requirements, orders, agreements, etc, designation of the purveyor, marking the material to be delivered, defining the quantity and quality of this material, prices, deadlines, place and manner of delivery, the monetary value of materials to be delivered in the future, etc.

Further columns on the cards are designated for inscribing data on the implementation of materials as this develops. Inscriptions, therefore, include: the data of implementation and the quantity of implemented material, amount of defective material, the designation of the deficiency, quantity of material rejected as a result of defects, amount of material accepted at lowered cost, size of decrease in cost, etc. On the basis of these data separate notes are maintained concerning delivery schedules, penalties for broken agreements, etc.

The basis for maintaining inscriptions on implementation are: entry assignations from warehouses, transportation letters or copies of bills from the purveyor with a notation establishing the quantity and quality of accepted materials, protocols concerning deficiencies discovered in the material, etc.

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Supply should be differentiated from the implementation of materials; implementation pertains to materials transmitted to a recipient, independently of whether these materials are still found in the warehouse of the purveyor or whether they have already been transmitted to the recipient; supply includes, on the other hand, only materials actually sent to the recipient.

The moment of implementation for supply should be considered the time when, according to the agreement or conditions of supply, the responsibility of the purveyor for the supplied material ends and the purveyor may demand an accounting, payment or acceptance of the bill.

It should be mentioned that materials supplied from the outside to a given transportation enterprise are subordinate to a quantitative and qualitative acceptance; materials from internal turnover among units of the same transportation enterprise, however, are subordinate basically only to quantitative acceptance. When delivery pertains to both amount and quality, the latter may not always correspond with the moment of qualitative delivery but can occur either later or earlier in time.

To describe the run of implementation from the viewpoint of individual more important materiel groups, independently of the above discussed reporting system, it is indicated to maintain a separate "collective" card file.

Each more important group of materials includes separate sections in the card file with columns for inscription of data on:
(1) planned requirements for a given material by quantity and quality;
(2) actual implementation also quantitatively and qualitatively.

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Data on the implementation of materials are summed up by the month. At the end of each quarter, we sum up the data from 3 months concerning the implementation of materials as well as inscribe data on the outgo of materials during this same quarterly period; finally we deduce the remainder for the next quarter.

3. Statistical Compilations on Supply of Material

Data included in the described card files represent the basis for elaborating statistical tables picturing the implementation of individual materials in comparison with the supply plan; the degree of plan implementation is characterized by percentage factors.

Separate statistical tables should include statistical compilations pertaining to:

(a) deadlines for receiving materials;

(b) completeness of supplied materials, i.e., inclusion within supply of all required collective parts.

It is obvious that nondelivery of materials on schedule, when there is a lack of the necessary supplies in warehouses, may precipitate difficulties in the realization of the production plan. These same obstacles may also manifest themselves in instances when materials are obtained only at the end of a month, regardless of the fact that from a formal point of view the monthly supply plan has been implemented.

Fulfillment of planned work may also be stopped when materials belonging to the same sets have been supplied in incommensurable amounts. With a low, e.g., 45%, factor for delivery of joints difficulties will arise in laying the planned quantity of rails, although the supply factor for rail delivery simultaneously may be very high, e.g., 95%.

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One of the tasks in the statistics of materiel supply is thus the delivery of analytical data for discovering similar causes for nonfulfillment of established production plans in their entirety.

The dynamics for quantities of supplies of designated materials over a period of several years is portrayed on tables compiled according to the index method. Such tables should show on the first line the supply of materials during the individual years of the period in natural or physical units. On the second line, the dynamics of supply amount are characterized by indexes, whereby the supply during the first year in a given period is accepted as the unit (1.00); the quantities of supplies during the following years are indicated by the appropriate figures which are relative and computed in relationship to 1.00. If the table is to include not designated materials but rather groups of materials or the global mass of supplies, it is necessary to express the quantity of supply in monetary units instead of natural or physical units. Monetary sums may express in this connection either one's own cost in obtaining the materials or the value of supplies in unchangeable prices. In the first instance the table illustrates the dynamics of investments for materiel equipment; in the second case, the dynamics of the physical quantity of supplies.

The qualitative composition of supplied materials may be defined by grouping materials according to the composition established in the terminology.

An important characteristic, necessary especially for the analysis of plan implementation for the supply of materials, is the grouping of delivered materials according to sources like planned agreements, emergency purchases, own auxiliary enterprises, orders, etc.

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The groupings indicated last facilitate the preparation of the so-called balance sheet for materials. This is the name for the compilation portraying the sources of delivered materials and, on the other hand, the purpose for which the materials have been expended (e.g., major overhauling, average or current repairs, exploitation requirements, etc), with a simultaneous indication of possible remains. Balance sheets for materials may be prepared either in natural and physical units or else in monetary units; the operation of monetary units is imperative, especially when the matter pertains to a balance sheet for a designated group of materials (e.g., rolled steel products, wooden materials, etc).

C. Storage and Turnover of Materials

1. Tasks in the Economy of Materiel Supply

The principal task in managing supplies of materials is the need to counteract all types of losses which may arise as the result of incorrect storage and irrational materiel turnover.

The economy of materials aims to attain this goal by encompassing the status of supplies and the movement of materials into a precise reporting system which will guarantee control as to:

(a) whether the stored materials correspond quantitatively with the notations in the reporting system;

(b) whether supplies of materials are supplemented in accordance with established needs concerning deadlines, quantity and quality, as well as whether the supplementation takes place within the framework of alloted financial media;

(c) whether detrimental remnants of materials arise.

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The object of reporting is thus the status of supplies as well as the turnover in materials, i.e., income and outgo. In its registration and statements, the reporting system utilizes natural and physical units (piece, set, units of measurement and weight) as well as monetary units. The simultaneous dual aspect of the object in this materiel economy, i.e., quantitative and qualitative, is caused by the fact that materiel supply must remain within the framework of sums foreseen in the transportation and fiscal plan for this purpose; all requirements as well as consumption of materials are established in natural or physical units and according to norms based on these same units. Planning in the field of materials' economy also utilizes a dual approach to this same object, computing the required materials according to norms expressed in natural and physical units as well as recomputing the obtained results into monetary sums. In this connection the income as well as the outgo of materials for the needs of the serviced official units must be reduced in the final result to monetary accounting.

2. Reported Prices of Materials

The problem of the reported prices of materials is reduced mainly to the question as to whether materiel reporting should be conducted according to real prices, computed separately for each supplied group, or according to uniform prices, i.e., planned and established for a given reporting period.

Real prices for individual components in materiel supplies represent either the catalogue price, reduced by discounts and increased by possible additional costs, or else the arithmetic mean resulting from the recomputation of prices for the supplies

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to date and prices for the materiel currently being delivered. In case of special difficulties when attempting to establish the real price as indicated above, an approximate price is accepted.

The level of uniform prices planned is established on the other hand so that all three component parts of this price, i.e., the cost of the material, the expenditure for delivery, and other outlays, are established ahead of time in the plan by computing the average weighted prices resulting from the agreements entered into for delivery which have been increased by the average transportation cost (delivery) as well as by the average for other costs.

3. Turnover of Materials

The turnover of materials is the acceptance of materiel by the warehouse (store) and releasing it from there on the basis of papers on income and outgo.

In the turnover of materials, we differentiate among:

(a) internal turnover -- within the framework of an organizational unit which functions on the basis of an internal economic cost accounting system;

(b) external turnover -- proceeding beyond the above indicated framework.

Proof of incoming materials is presented by the entrance assignation which is the basis for reporting and entering the materials into the accounting system.

The mentioned assignation at times also serves in place of a protocol on the acceptance of materials by the recipient.

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Proof of outgo, which represents the basis for the registration and accounting of released materials, is the outgoing assignation given by the warehouse on the basis of materiel requirements and an order to issue the materials. A materiel requirement is made out by an organizational unit, requesting the issuance of the materials by the warehouse; a component part of this document is the order for the issue, granted by an organ with competence to decide this matter.

4. Quantitative Reporting

Current reporting on the status of supplies in a warehouse and on the turnover in terms of quantity is conducted by the warehouse with the aid of a separate cardfile on the basis of incoming and outgoing assignations.

For each type of material, designated by a separate catalogue number, and for each measurement a separate card is entered into the cardfile. Each card -- apart from the columns designated for current inscription of data concerning the individual income and outgo -- includes in the initial column designated for inscribing the account symbol a technical description of the material, the place of storage, binding norms concerning supply, etc.

The above mentioned symbol for accounts may be expressed as a fraction, whose numerator is the number in the quantitative cardfile, the denominator being the number of the bookkeeping account for a given group of materials.

Cardfiles are divided into 4 separate divisions depending upon the origin of materials, namely: (a) from supplies or own production; (b) originating from returns in exchange for new materials issued; (c) designated for scrap; and (d) still usable remains.

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To facilitate control and rapid discovery of the appropriate card, a separate index is usually maintained for the cardfile.

At the very moment the material is submitted to reporting the materials are accepted by the warehouse or released by it.

The status of supplies in a warehouse is established by contrasting the income with the outgo, and not by direct computation which is applied only in cases of control or inventory.

5. Quantitative-Value Reporting

Quantitative-value reporting on the status and turnover of materials is conducted by the bookkeeping of the warehouse with the assistance of a separate cardfile which, apart from columns designated for the indication of quantity, also include columns to picture the values of income, outgo, and final supply. This carf-file represents the basis of control and, therefore, bookkeeping in relationship to the warehouse occupies a superior position from this point of view. The composition of the cardfile is also similar to that of the quantitative cardfile.

The symbol for accounts in the cards of the quantitative-value cardfile should correspond to the symbol in the quantitative cardfile. Also the inscriptions for the quantitative-value cardfile should be maintained under the same number and position as those in the quantitative cardfile. This facilitates the current systematic control over the conformity between inscriptions in both cardfiling systems. The quantitative-value cardfile may be kept in the form of copies from the daily entries in the books. A peculiarity here is the fact that after each inscription, related to the turnover, the remainder (supply) is deduced in the quantitative and value columns.

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The bases for bookkeeping are the assignations for income and outgo, sent by the warehouse supervisor after the implementation of inscriptions for the appropriate columns.

Materials stemming from other organizational units in transportation enterprises are accepted according to indicated prices on internal invoices or annotations by the purveying unit.

6. Supply Norms

To guarantee an uninterrupted run in the production process and the implementation of planned tasks, it is necessary to have a designated supply of productive media, i.e., basic materials, auxiliary materials, fuels, etc which may be issued for use at once.

The supply of productive media, located in an enterprise, undergoes a systematic and direct procedure in order to supply places of work, i.e., points where the process of materiel consumption takes place.

The warehouse supply of a given materiel assortment comprises:

(a) the production supply (current);

(b) the minimum supply (insurance, guarantee).

The production supply of materials in a warehouse represents the quantity of material, changeable as it is being consumed, which should be found at a given time in storage and which is imperative for the execution of planned production and for the maintenance of continuity of movement from the time in which the quantity is measured to the time it is possible to utilize such material for

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the next delivery. Production supplies arise from the fact that materials supplied in lots are not consumed immediately but by degree according to their need and are then renewed again; thus they represent a changeable quantity, dependent under given conditions of consumption upon the amount of materials supplied and the schedules for renewal. The largest production supply is thus equal to the planned consumption of material during the period between the two successive deliveries:

$$Z_{prod.} = T_1 \times B_{max.},$$

where $Z_{prod.}$ - the largest production supply;

T_1 - the period between two successive deliveries, expressed in calendar days (and not in labor-days);

$B_{max.}$ - the average daily consumption of materials, computed per one calendar day on the basis of the highest quarterly consumption during a planned year.

The above formula indicates that T_1 should be as short as possible, taking into consideration other delivery conditions, because only through frequent delivery of rationally smaller allotments of materials can we attain a decrease in the production supply at the warehouse and, therefore, obtain on this sector advantages stemming from a speed-up in the runs of turnover media. An obstacle in this process are the conditions for the production of materials, transportation, etc (see below).

The minimum warehouse supply Z_{min} is the quantity of materials necessary for fulfilling planned production and the maintenance of continuity in movement, computed for the period of time during which supply is able to deliver and release for consumption a given material

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by means of an extraordinary supply like the allotment above the plan, on the spot purchase, transfer, etc. The minimum supply may be touched in instances where the production supply has been exhausted as a result of a situation where the scheduled supplies have not arrived or when an unforseen or emergency increase in the consumption of a given assortment occurs.

The minimum quantity of supply is basically a permanent quantity during the year. The establishment of a level for this amount depends on the regularity of supplies as well as the possibilities of obtaining the given material by way of a special delivery.

The quantity of the minimum supply is expressed by the following formula:

$$Z_{min} = B_{max} \times T,$$

where T - is the time expressed in calendar days necessary for finding the material, taking care of all activities connected with allotment, purchase, transportation, acceptance, etc of the given material in order to supplement the minimum supply that has been impaired.

In transportation enterprises, like service-production ones, the minimum supply is established only for certain especially important materials like coal, fuel, grease, etc. In relationship to the remaining materials, only a production supply is created.

The maximum supply in storage Z_{max} is the sum of the minimum warehouse supply and the highest production supply:

$$Z_{max} = Z_{min} + Z_{prod.}$$

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If the maximum supply should be expressed in days (calendar), then it will be equal to:

$$T + T_1.$$

The warehouse normative "N" is the quantity of material in the storage place designating the average status of warehouse supply, around which the actual status of materials in storage oscillate in highs or lows; in this connection, the oscillations in warehouse statuses should not decrease below the minimum supply nor increase above the maximum supply.

The warehouse normative is computed basically according to the formula:

$$N = Z_{min} + \frac{Z_{prod}}{2}.$$

If the normative should be expressed in calendar days, then it will be equal to

$$T + \frac{T_1}{2}.$$

The warehouse normative serves among other things to designate the monetary value of storage supplies necessary for the implementation of continuity in production.

In establishing the production supply, the maximum warehouse supply, and the storage normative, a decisive role is played by the so-called average frequency of supplies. That is the name for the average time which expires between deliveries, computed in calendar days. The longevity of intervals between the successive deliveries is dependent in practice upon the production conditions of work in the delivery-shops and in the recipient-shops, upon the

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possibilities for the completion of groups of raw materials, other materials, etc, upon the address of one of the recipients, upon conditions for receipt, upon transportation conditions, etc.

The average frequency of deliveries is designated by the following formula:

$$f = \frac{\sum nx}{\sum n},$$

where f - the average frequency of deliveries, expressed in calendar days;

n - the number of deliveries;

x - the intervals between deliveries, expressed in calendar days;

$\sum$ - the sign for the summation process.

The intervening warehouse status "I" arises at the moment when the production supply falls below the quantity necessary for covering the consumption only during the period of time necessary for the conduct of successful intervention, guaranteeing successive and normal delivery within the framework of orders placed.

The attainment of a warehouse intervention status, minimum or maximum, should be communicated immediately by the man maintaining the storage cardfile to the warehouse authorities so that the latter may take the necessary steps for intervention.

As far as the spare parts necessary for repairs and overhauls are concerned as well as inventory of little value and objects of short duration, normatives are not established according to the supply per days but according to directives given by statistics of turnover media on Page 357.

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The special warehouse supply "S" is the supply of materials created in storage on the order to the superior unit or other agencies authorized to do this. Special supplies may not be utilized for regular production goals, and the quantity of these supplies as well as the method for outgo should be defined by the directive which orders the establishment of these supplies.

Warehouse supplies enter into the composition of turnover media in transportation enterprises, and in the total value of these media they represent the largest position. The maintenance of warehouse supplies at a level sufficiently low for given conditions of work by establishing the appropriate norms for warehouse supplies is of tremendous importance for a speed-up in the run of turnover media, simultaneously guaranteeing against losses to the enterprise which could result from a prolonged storage of materials in surplus amounts.

7. Reporting

Apart from conducting the quantitative-value cardfiles, materiel bookkeeping also has the duty of preparing monthly accounts on the purchase of materials which computes the deliveries encompassed by the invoices of the purveyors as well as deliveries for which invoices have not arrived by the end of the month. Computations on purchases are also prepared for fiscal accounting purposes.

Reporting data supplied to the main financial bookkeeping office in this manner are compiled according to groups of materials for which a separate numeration has been established in chapter XI of the Branch Plan for Accounts (e.g., 125 auxiliary materials, 126 fuels, 128 nonpermanent objects); fiscal accounting, therefore,

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inscribes the reporting data only from the monetary point of view with a breakdown into designated groups of materials but without the numerical framework.

The above indicated reporting system is characterized by:

(1) reporting data received in an accelerated course;

(2) reporting data being simultaneously accounting materials;

(3) receiving through bookkeeping accurate data in a monetary framework concerning the origin of materiel groups, on the consumers of these materials (units, services), on the destination of materials (for exploitation, major repairs).

Quantitative data on the turnover in materials (in natural or monetary units) are reported monthly by materials' bookkeeping with the assistance of other statements called the "Main Specification on the Turnover of Materials." This specification represents an analysis for the individual synthetic accounts in chapter XI of the Branch Plan for Accounts. It is obvious that the remainder of the quantitative-value cardfiles must correspond with the appropriate remainders which were deduced in the specification mentioned.

8. Statistical Compilations

Statistical compilations discussed below in absolute numbers as well as the appropriate derivative numerical characteristics describe and characterize the economics of materiel supply from the quantitative point of view, i.e., in natural or physical characteristics and in terms of money; the monetary framework must be applied especially when the matter pertains to a designated group or to the total of materials in warehouses.

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Statistical compilations, describing the quantitative aspect of managing supplies of materials, include tables illustrating the status of supplies and the dynamics of outgoing materiel. These compilations, similarly also to statistical tables refering to the dynamics of quantities delivered, fulfill (in monetary terms) their task only when we apply unchangeable prices to the compared periods being reported upon. Then the values included on the table express the changes taking place in the physical quantity of materiel supplies or in their outgoing process.

To characterize the size of these changes over a period of several years, we utilize indexes; depending on the purpose of the compilations, quantities for all of the successive years are relative quantities in relationship to the quantity of the base year accepted as being 1.00 (index with an unchangeable base), or they are relative quantities only in relationship to the preceding year (chain index). In this second instance, the index numbers for a given year will express the status of supply or the outgo of materials in comparison with the preceding year.

The mentioned index factors characterize the total quantity of work for a given warehouse or a network of storage places, and they are helpful in planning the outgo of materials, setting norms for employment, establishing the dimensions for necessary storage space, etc.

On the basis of the supply status and the outgoing quantities of materials, one may compute the so-called number of turnovers, characterizing the qualitative aspect of the management of supply materials.

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The number of turnovers executed during a reporting period by a given part or by the total of warehouse supplies is designated namely with the use of a factor for the velocity of turnover, according to the following formula:

$$O = \frac{R}{S},$$

where O - the number of turnovers during the reporting period;

R - the total outgo of a designated part or of all materials during a given period;

S - the total for the average remainder of the appropriate part of all materials during a given period.

The average remainder in materials is computed usually as the arithmetic mean of the remainder at the beginning and at the end of the reporting period.

Examples. During the quarter the outgo of fuel amounted to two million zlotys; in this connection the warehouse remainder of fuel at the beginning of the quarter was worth 200,000 zlotys, and at the end of the quarter 300,000 zlotys.

$$O = \frac{2{,}000{,}000}{\frac{200{,}000 + 300{,}000}{2}} = 8$$

It should be noticed that the above indicated method for computing the average remainders may at times lead to erroneous results; it is based on warehouse remainders which have been checked on two days only, i.e., at the beginning and at the end of the reporting period. The correct method is to compute the average remnant as an arithmetic mean, deduced for the remainder on all individual days of a given reporting period.

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The above formula $O = \frac{R}{S}$ also serves for computing a planned number of turnovers; in this connection, "R" should be accepted for the planned outgo of materials and "S" as the warehouse normative which actually represents the planned average for the remainder.

There is a close relationship between the number of turnovers and the outgo of materials as well as the average remainder; this ratio permits us to compute one of these quantities if the two other ones are known; namely:

(1) $R = O \times S$;

(2) $S = \frac{R}{O}$.

From the formula given under (2) above, it appears that by maintaining the same number of turnovers (O), the average remainder or warehouse normative must be so much greater as the actual or planned outgo of materials is larger during a given period.

Example. In relationship to a designated material or to a group of materials, it has been established that the warehouse has a planned factor of turnover velocity which is 6. With a planned annual outgo equal to 1,800,000 zlotys the warehouse normative will amount to 1,800,000 : 6 = 300,000 zlotys; with an annual outgo of 2,100,000 zlotys and while maintaining the same number of turnovers the average remainder (or warehouse normative) will increase up to 350,000 zlotys.

If the actual outgo of a given material will increase or decrease in relationship to that which has been planned, the authority over the warehouse will want to fulfill the established number of

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turnovers and must maintain the average remainder at the same level, so

(1) they will remain within the limits of the production supply in the warehouse;

(2) they will correspond simultaneously with actual needs;

(3) the actual outgo of materials (groups of materials), divided by the average remainder, will give as a result the same planned factor for turnover velocity (in the above example 0 = 6).

The turnover time in days, i.e., the length of time for one turnover, is computed by dividing the number of days included within a given reporting period by the number of turnovers completed during this period by warehouse materials.

The appropriate formula has this form:

$$d = \frac{H}{O},$$

where d - the turnover time in days;

H - the number of days in a given period (usually accepted are 30, 90, or 360 days);

O - the number of turnovers completed by a given material or a group of materials during this same period.

The longevity of one turnover in days may also be established with the need for previously computing the number of turnovers within a given period, and namely with the use of this formula:

$$R : S = H : d,$$

where the terms R, S, H, and d have the meanings indicated previously. Therefore

$$d = \frac{S \times H}{R}.$$

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The above cited formula also presents an advantage that in connection with known values for three of the symbols, it is possible to compute very easily the unknown quantity of the fourth symbol and namely:

$$R = \frac{S \times H}{d} \quad \text{and} \quad S = \frac{R \times d}{H} .$$

D. Consumption of Materials

1. Registration of Consumption

Reporting and statistics in the field of materiel consumption by consumers has the following purposes:

(a) establishment of actual quantities for consumption of materials as an exploitation requirement as well as for investments and major repairs, implemented by economic means;

(b) establishment of harmony between consumption and the directives of the plan;

(c) control as to whether the materials correspond to the established norms for consumption in their quantitative and monetary aspects as well as whether and to what degree the directives have been applied in connection with decreasing the consumption of materials;

(d) analysis of causes for established deviations from norms of consumption.

The outgo assignation issued by the warehouse (storage), when it releases material to the user, includes data which could be useful for the above purposes; it cannot be the basis, however, for reporting and statistics on the consumption of materials by the user. It is not, thus, excluded that the recipient will use the material for some other purpose than is indicated on the outgoing

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assignation, that he will use it during a different reporting period, or that he will even return the material in part or in its entirety to the warehouse (storage) as inapplicable, surplus, etc.

It appears from this that the recipients should maintain a separate reporting system which would include information on when and for what purpose the obtained material has been used, whether the consumption corresponded with the plan, and whether it harmonizes with the established norms for consumption. Such a type of accurate reporting has been undertaken thus far in production shops, in the exploitation of fuel, greases, etc. The director of a train or those servicing units of rolling stock with their own mechanical driving force namely register in their documents (specification on locomotive work, route sheet, etc) the quantities of fuel and grease taken, which permits an accurate establishment of the total outgo on this account.

Registration of fuel and grease on the same document, which serves at the same time for the registration of data on the amount of transportation work completed, will permit not only the computation of fuel and grease consumption in relationship to the implemented runs but will also create considerable possibilities for analysis of the relationship between consumption and different labor conditions like the type of vehicle, road profile, and even the individual talents of the engineer, director, stoker, etc.

As far as the economy of coal is concerned, it should be noted that warehouse reporting registers in units of weight for coal actually in storage. On a general scale, the actual coal is calculated into so-called agreed upon or computed fuel (with 7,000

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calories in one kilogram). For example, 20 tons of coal with a caloric value of 6,500 calorie-kilograms will equal 18,571 tons of agreed upon fuel in the 7,000 calorie type ($20 \times \frac{6,500}{7,000} = 18,571$).

Coal, coke, and briquets are registered separately when they are issued for heating and other purposes, according to established norms.

Reporting data on the consumption of materials may be grouped according to two basic characteristics: (1) according to the purpose for which the material has been used (e.g., current repairs of freight cars, general overhaul of locomotives); and also (2) according to the category (name) of material. Combined groupings according to both indicated characteristics lead to the most essential matter, namely to the statistical establishment of consumption for a given material in a designated purpose as well as -- in case of need -- to the statistical centering of norms for the consumption of materials.

2. Norms for Consumption of Materials

Norms on the consumption of materials are of special weight for an accurate and actual elaboration of the plan to supply enterprises and to control plan fulfillment. Planning the supply of materials begins with lower organizational units which consume material, since only they can actually and precisely plan the consumption of materials. Their consumption plan is the foundation upon which the PKP enterprise bases its construction of the entire supply plan in the collective plan.

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The plan for the consumption of materials, worked out by lower units must on its part rest upon norms for consumption. Even minor deviations in the establishment of correct consumption norms, in their relationship to mass materials, can cause serious errors in the establishment of materiel consumption and finally in planned supply.

The norm for the consumption of materials is the imperatively needed gross quantity of material which should be utilized in connection with a designated technology of production in order to complete a unit of the same kind of product per unit of labor or per unit of time.

Norms for the consumption of materials with regard to the method by which they have been established are divided into technical and into statistical.

The technical consumption norm is the optimum, scientifically and technically computed quantity of a designated raw material or material which should be used under designated production conditions, with the maintenance of established qualitative standards for the production of the designated object or the designated manufactured unit foreseen by the plan.

In the technical computation of the consumption norm, it is necessary to consider and present separately:

(1) the theoretical consumption (net);

(2) the complete and full consumption (gross).

The theoretical consumption is based upon the theoretical computation of the necessary materiel quantity for a given unit of

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completed manufacture, without considering the losses and remnants arising during the production phase or in the phase of supplying materials.

Complete and full consumption includes

(1) theoretical consumption;

(2) losses and remnants arising in the production process, the so-called production losses;

(3) extraproduction losses, if such exist and are justified; losses arising in the material before it has been introduced into the production process belong here, like damages or losses due to defects in the material. The basis for establishing norms should represent fundamentally the technological norms of consumption.

In the railroad administration there is a preponderance of repair production with an extensive and varied character; the technical norms of consumption have hitherto been worked out only for new products and in small quantities, and therefore would not exert much influence upon the decrease in the general consumption of materials.

The statistical norm for the consumption of materials is the amount of material established from analyzing statistical data on the actual material consumption during appropriate periods of time or from the pertinent products produced and needed for the manufacture of a uniform product per labor unit or unit of time.

Statistical norms for consumption in industry have a rather transitory significance until the appropriate technical norms have been computed; these computations are very difficult and complex.

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More extensive importance, on the other hand, due to causes provided before is attached to statistical norms in railroad enterprises.

For establishing statistical norms we compute the actual unit consumption of materials according to the formula:

$$P = \frac{R}{Q},$$

where P - the actual unit consumption of materials;

R - the total amount of used up material;

Q - the amount of the uniform product manufactured or the amount of completed work or time during which the consumption of material took place.

When selecting the unit of reference "Q," the practicality and facility with which the norm can be applied should be borne in mind; i.e., the norm which will be established on the basis of statistical data.

In railroad transportation it was long debated, whether coal consumption by locomotives should be computed in relationship to the run of a steam engine (per 100 locomotive-kilometers) or whether this should be done with reference to the completed transportation work (per 1,000 ton-kilometers gross).

Statistical data on the consumption of materials registers the place of work which is using the material on so-called cards for computing statistical norms on materiel consumption; thus each card for computation should include only an assortment of one materiel group and one purpose for which the material has been utilized.

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Statistical data on the consumption of materials may also be taken from the warehouse cardfiles, from the storage copies of outgo assignations, from consumption books, etc.

The established norms for consumption cannot represent a statistical average but must be average-progressive. This indicates that in comparison with statistical data on the actual consumption of material, the norms should be such as to establish more economical unit consumption of materials, as well as unit consumption attainable under given conditions.

Statistical norms on consumption, worked out for the individual organizational units, may differ according to quantity since they not only base themselves upon various statistical data concerning consumption, but must also consider local labor conditions.

The factor for the consumption of materials (or group of materials) is computed or established, for the entire PKP enterprise or for its individual organizational units on a higher level, in the form of a relationship between the quantity of material consumed and the amount or product(s) completed, the quantity of work or its value, or of time during which the consumption of materials occurs.

The factor for consumption of materials is supplied especially

(1) to current and periodical control over consumption of the materials on a general scale;

(2) to current and periodic comparison among the consumption of materials within different organizational units or for various periods of time;

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(3) to plan the changes in norms of materiel consumption;

(4) to establish a framework for requirements of basic materials.

The mentioned factor is computed according to the formula:

$$W_z = \frac{R}{Q} ,$$

where W_z - the factor for consumption of materials;

R - the total quantity of consumed material(s) in a given higher organizational unit or for the entire network;

Q - the number of created products or the quantity of completed work, or their value, or time in which the consumption of materials took place.

The above formula is similar to the one for computing the actual unit consumption of materials, with a difference in the meanings of "R" and "Q" in both formulas depending mainly upon the scale size or finally upon the different units of reference (Q).

The following specification provides as an example certain units of reference applied on the railroads:

Purposes for Materiel Consumption	Unit of Reference
(1) Lighting of facilities and signalling equipment	1,000 hours of light
(2) Greasing of locomotives	1,000 locomotive-kilometers
(3) Greasing of freight cars	10,000 axle-kilometers
(4) Greasing of passenger cars	10,000 axle-kilometers
(5) Current repair of locomotives	10,000 locomotive-kilometers
(6) Current repair of freight cars	1,000,000 axle-kilometers
(7) Current repair of passenger cars	1,000,000 axle-kilometers
(8) Implementation of new crossings	1 ton

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(9) Reconstruction of the surface	1 ton
(10) Repairs of railroad surfaces	1 kilometer of track
(11) Repairs of bridges, viaducts and culverts	100 m
(12) Conservation and current maintenance of buildings	100 cu m
(13) Saturation of wood	100 cu m
(14) Heating of accomodations	1,000 cu m

The collective factor (aggregate index) for the unit consumption of material. When comparing the unit consumption of materials during two different time periods, the following variations manifest themselves:

(a) there arises the necessity for comparing the quantities of consumption for the same type of material in order to implement a larger amount of different kinds of work;

(b) the consumption of different materials should be compared for the implementation of a larger amount of various types of work.

The first variant comes into play, e.g., when dealing with the comparative prices of coal consumption by locomotives since all kinds of coal may be expressed in the same units of agreed upon fuel. The basis for comparison in such instances will be the quantitative consumption of the material; the following formula serves for the computation of the comparative index quantity:

$$K_j = \frac{\sum P_1 \; Q_1}{\sum P_0 \; Q_1},$$

where K_j - the aggregate index for unit consumption of materials;

P_1 - the unit consumption of material during the period being reported upon;

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P_o - unit consumption of material during the initial period;

Q_1 - quantity of implemented work during the reporting period.

The symbol $\sum$ designates that the factor includes various quantities of work and different rates of unit consumption for material, the products of which require summation.

Example. In a designated locomotive shed the average consumption of coal per 1,000 gross ton-kilometers during the reporting month amounted to 78.62 tons per one steam engine in passenger traffic, but 41.04 tons in freight traffic; for the initial month, however, the appropriate figures were 77.17 and 43.14 tons respectively; during the reporting month, steam engines in passenger traffic completed a total of 29,549,000 gross ton-kilometers and locomotives in freight traffic some 146,505,000 gross ton-kilometers. Computation of the index per unit of coal consumption according to the above indicated formula presents itself as follows:

$$\frac{78.62 \times 29,549 + 41.04 \times 146,505}{77.17 \times 29,549 + 43.14 \times 146,505} = 0.9692$$

This indicates that in a given instance the unit, i.e., per 1,000 gross ton-kilometers, consumption of coal during the reporting month decreased by 1.0 - 0.9692 = 0.0308, or by 3.08% in relationship to the initial period.

In case of the second variation, i.e., when comparing the unit consumption of various materials for different kinds of work over two separate periods, the basis for a comparative evaluation -- due to the variety of materials entering into the picture -- cannot be a quantitative form of consumption but must be the monetary one. For this we can use the previous formula, introducing into the

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numerator and into the denominator as a further factor also the catalogue prices for used materials from the reporting period. The formula discussed will then take the following form:

$$K_j = \frac{\sum P_1 \quad Q_1 \; C_1}{\sum P_o \quad Q_1 \; C_1} ,$$

where K_j - is the aggregate index for unit consumption of materials;

P_1 - is the unit consumption of materials during the reporting period;

Q_1 - is the amount of work during the reporting period;

C_1 - is the catalogue price of consumed materials during the reporting period;

P_o - is the unit consumption of materials during the initial period.

The symbol $\sum$ indicates that the factors include different types of work, various units of consumption, and dissimilar prices for materials, the products of which require summation.

To compare the reporting period with planned quantities, it is necessary to substitute P_{pl}, i.e., planned norms for consumption of materials, in place of P_o in the above formula.

CHAPTER VI. THE STATISTICS OF PERMANENT MEDIA

1. The Concept of Permanent Media

The permanent media of an enterprise include especially those property components not consumed entirely during a single usage or in the course of one production cycle but which maintain their natural and original form and have only a slightly smaller capacity for usage than at first, serving over a longer period of time in the production process.

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The value of permanent media enters into the composition of the own costs of the created production but only in the part corresponding to the degree that permanent media are consumed during a given cycle of production. This is the difference between permanent media and turnover media (raw materials, fuels, materiel) which basically are consumed in their entirety during the production process and with their total value enter into the value composition of the created product or service.

In accounting own costs, not only expenditures for the exploitation process (compensation for work, value of raw materials, materiel, fuels, etc) are considered but also so-called amortization deductions, designated for major repairs of permanent media and for the renewal of consumed property components (amortization of the original value for permanent media).

An increasing participation of amortization deductions in own costs indicates a growth of technical equipment in an enterprise and also a larger participation of objectivized work in permanent media compared with live work. Under such conditions the total labor efficiency as a rule increases, whereas own unit costs decrease.

Whether to include the individual property components among permanent media or turnover media is decided by classification criteria, established by investment instructions binding for the given year, i.e., accounting period. In compliance with, e.g., the instruction on preparing an investment plan for 1953, permanent media include such property objects whose value when new amounted to more than 300 zlotys and simultaneously the period of their usage goes beyond one year.

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The low level at which the value criterion -- 300 zlotys -- was established precipitates the situation in which numerous object belong among the permanent media, when it is more convenient to purchase, store in warehouses, and issue to future consumers on principles established for these materials. The result is that permanent media are found not only in enterprises for designated consumers but also in storage (warehouse).

Three principal methods of grouping permanent media exist, and namely:

a. Classification by Type

Depending upon the economic purpose of permanent media, the classification by type divides these media into appropriate category groups.

For requirements of general inventory, which should be conducted in the country according to the status of permanent media as of 1 January 1955, the following category classification has been adopted at the highest level:

Group 1 -- buildings;

Group 2 -- construction;

Group 3 -- boilers and power machinery;

Group 4 -- work machines and apparatus for general application;

Group 5 -- work machines and apparatus for special lines;

Group 6 -- technical equipment;

Group 7 -- transportation media.

For requirements connected with the accounting of own costs, we also accept a grouping of permanent media into:

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(1) those for shops, serving to implement production activity (basic and auxiliary) of a given enterprise in general administration, exploitation, production, storage, supply, repairs, etc.

(2) those apart from the shops, serving for social action, housing management, agricultural, or other activity beyond the shop.

b. Grouping According to Status of Usefulness

Regardless of the above category classification, all permanent media depending upon the status of their usefulness are grouped into

- active;
- inactive;
- qualified for liquidation.

The appropriate instructions in the matter of inventory taking for the individual categories of permanent media establish norms as to the instances in which permanent media may be counted among the inactive or those designated for liquidation.

c. Grouping According to Purpose

Depending upon the role to be played by the individual components of permanent property in the social process of reproduction, the permanent media are grouped into productive and nonproductive; among the latter are, e.g., residential buildings, schools and hospitals, their equipment, etc.

2. Tasks and Methods in Statistics of Permanent Media

The tasks of statistics for permanent media in PKP enterprises may be divided in the following manner:

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(1) Characterization of permanent media on a territorial, organizational, exploitation as well as structural cross-section (which was already discussed in sub-chapter 1); in this connection

(a) grouping of permanent media in a territorial and organizational cross-section enables the description of equipment in the mentioned media for individual services, lines as well as organizational units;

(b) grouping according to exploitation, production or economic purpose permits the characterization of the structure in permanent media;

(c) grouping according to status of usefulness for production and exploitation purposes (especially for media: active and inactive, unnecessary, incapable of use, destroyed or damaged and not rebuilt) enables the characterization of these media in cross-section as to their usefulness.

(2) Using the accumulation of enterprises, the state covers among other things also investment expenditures which manifest themselves in the growth of permanent media in all fields of the national economy and also in railroad transportation.

Permanent media represent for the PKP enterprises a permanent production-technical foundation in their exploitation activities.

Under conditions of the economic cost accounting system, the PKP enterprise is responsible, in particular, for the entirety of its permanent media, for the amortization of their value and deductions for the amortization fund, for repairs and overhauling of permanent media, which aim to maintain these media in useful condition, and finally, for the implementation of the investment plan.

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The tasks which belong to statistics in this field are based on

(a) the characterization of the degree to which permanent media have been consumed and in this connection the amortization of value.

(b) the characterization of the degree of increase for the quantity or quality of permanent media.

Therefore the above indicated under (1) and (2) tasks of statistics should be understood not only in a statistical sense, as the characterization of permanent media at a given moment or a period, but also in a dynamic sense, i.e., in a cross-section of changes taking place during a longer designated period of time with reference to the quantity of permanent media, their distribution, structure, degree of consumption, quality and quantity of investment for purposes of simple or extensive reproduction, etc.

(3) The tasks of statistics for permanent media also include the establishment of a basis for the preparation of annual deductions for the amortization fund, from which the monetary means should be taken to finance major repairs of permanent media and to substitute used media with new ones or to increase them.

In connection with the above presented tasks, statistical research and elaborations must encompass permanent media in a natural (physical) and monetary sense as well as monetary means designated for repairs or for the substitution of used, destroyed, etc, media.

The statistical material required for permanent media described in a static and dynamic sense is obtained through two complementary methods, and namely:

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(1) Through a complete inventory which is usually prepared as a listing of permanent media. A full inventory represents the point of departure for all further investigations and compilations; after the completion of a total inventory it is necessary to register on a current basis the changes taking place thereafter in order to collect pertinent data on the quantity and status of permanent media from the natural point of view as well as on their quality and also data on the monetary media needed to implement major overhauls.

(2) Through current registration of changes in the quantity or in the value of permanent media which includes:

Increase in amount or value	Decrease in amount or value
(a) resulting from new investments, purchases and amortization	
through new investments;	through amortization of value;
through purchase (buying) of permanent media;	through sale of permanent media (in instances permitted according to binding regulations);
(b) as a result of quantitative changes in the composition of permanent media	
through attaching a different enterprise or shop;	through transfering (returning) a shop;
through acceptance of media which are permanent;	through transmission of media which are permanent;
	through liquidation in total or in part of permanent media that are used, destroyed, nonexistent; lost, or damaged.
(c) as a result of revaluation, recounting or reclassification	
by increasing the value as a result of revaluation;	by decreasing the value through revaluation;
by discovering the hitherto unregistered permanent media;	by crossing off in error the registered but nonexistent part in permanent media;
by reclassification of nonpermanent media into permanent media.	by reclassifying permanent media into nonpermanent media.

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The current registration may also include the relocation of permanent media within the framework of the same enterprise, connected with ultimate changes in the quantity and quality of permanent media.

3. Inventory of Permanent Media

(In April 1952 a separate commission was created to work out the methods for an inventory of permanent media on a national scale. In connection with the work of this commission, we may expect changes in the inventory methods for permanent media which will be discussed further on.)

When taking inventory, we list as a rule under different positions the so-called inventory objects, i.e., those components of the permanent property (objects) which

(a) possess an independent purpose as well as individually defined properties from the point of view of production ability and consumption capacity;

(b) are separated in space or possess definitely marked limits of contact with other objects within the inventory.

Inventory taking for our own permanent media may be

(a) partial, when we list either one or several permanent media as a rule or else work only in certain of the organizational units in an enterprise, e.g., in the course of control;

(b) complete, when the listing as a rule encompasses all permanent media to be found on a designated day in all organizational units in an enterprise, basically with a simultaneous revaluation of quality and the establishment of a consumption level.

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The total inventory of permanent media in the above meaning is usually undertaken only in case of an essential requirement, due to the large amount of labor and the connected costs.

It is a matter of considerable importance that the inventory process register those characteristics of permanent media like quality, quantity, destination, status, and value which are necessary for a final characterization of permanent media and their management from a rational point of view.

An example entering into the consideration of characteristics may be the partial inventory of permanent media, undertaken by the PKP in 1950, and namely in all mechanical shops (currently repair shops) and other separated economic units like highway shops, electro-technical, electro-traction, graphics shops, saturation points, ferry boats, and funicular railroads. In this inventory process, property components have been divided into separate listing sheets which

(a) have remained in normal usage;

(b) were unnecessary or unadaptable for use;

(c) were destroyed or damaged and not rebuilt.

Also on separate listing sheets, permanent media in shops have been collected (currently under group A 001) as have also permanent media outside the shops.

The listing sheets included columns for the registration of the following more important characteristics:

(1) locality (region, listing area) and name of the official unit which holds in its possession the registered component of property as well as the name of the service to which the given unit where inventory is being taken is subordinate.

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(2) the name of the property component, corresponding with the name accepted in the terminology of permanent media, i.e., classification of property components by type;

(3) the number in the last classification row for a given component of property;

(4) the amount (quantity) of the property component according to the measurements and computations that have been completed, expressed in units of measurement which have been accepted by the terminology of permanent media;

(5) the original value of the property component in a new condition, designated in unchangeable prices and in circulation prices;

(6) the year of construction for objects and equipment as well as the year of the last construction;

(7) the degree of consumption of the property component in percent at the time of inventory;

(8) the amortization sum of the property component at the moment of inventory, which is the product of the original value and the percentage of consumption;

(9) the net value of the property component at the moment of inventory, as the difference between the original value and the amortization sum;

(10) characteristics of the property component from the technical, financial, and economic point of view.

It is necessary to differentiate from the above discussed inventory process of own permanent media, the periodic inventory concluded at the end of each year for requirements in connection with preparation of an annual balance sheet. By the mentioned periodic inventory should be understood as a rule the listing of

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all components of the permanent and turnover media which are at the disposal of the enterprise, i.e., independently of whose property they represent as well as the establishment and reciprocal check on all financial accounts; permanent media are listed for this purpose basically without valuation, and the data on value are accepted at inventory according to book value.

4. Specification of Permanent Media

The large quantity and variety of permanent media makes it necessary, for inventory requirements and a rational economy of permanent media, that they be encompassed by a specification including the names of individual permanent property components together with a division into groups according to designated criteria (properties).

Such a type of "Specification for Permanent Media" thus primarily aims to make the category classification uniform as well as the nomenclature (terminology) of permanent media subordinate to the inventory.

The nomenclature of permanent media differs from the terminology accepted in materials' economy or in statistics of transportation, because permanent media are not basically an object in the economy of materials, but merely a part of the permanent media that can be the object of transportation, and namely the mobile things.

Broadening the category classification on the specification for permanent media is based upon a grouping in several degrees according to criteria so selected that in the individual and

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following sub-groups will be found all those objects most closely related to one another either from the point of view of construction properties or on the basis of generating aspects, equipment, etc. Each criterion in grouping should, therefore, guarantee the separation from itself of objects the least similar. In the individual sub-groups of the last degree objects of the same type or related to one another in all characteristics should be found.

For purposes of the already indicated general inventory within the country, the "Specification of Permanent Media" has accepted a grouping on the basis of five degrees, so-called levels; the highest of which bears the name "group," the following in sequence level called a "sub-group," then a "type," and the last level is a "class." At each level a decimal composition has been accepted (from 0 to 9) and the position "other" or "remaining" is placed in the grouping always under the symbol "9."

The method of grouping at the highest level, as accepted in the "Specification of Permanent Media," i.e., according to "groups," has already been discussed in sub-chapter 1 in connection with the survey of category classification.

The complete "Category of Permanent Media" will also include in a supplement a simplified classification according to types, within the area of the following three groups for permanent media, not subordinate to the general inventory:

(1) apparatus, equipment and movables;

(2) live inventory;

(3) objects as well as items of culture and art.

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In the discussed "Specification of Permanent Media," on the first three levels, a grouping has been applied according to technical destination for objects of production or according to usefulness for nonproduction objects.

In such a manner, e.g., in group seven "transportation media," at the sub-group level the following grouping occurs designation according to type of transportation):

0 - rail rolling stock;

1 - automotive vehicles;

2 - other vehicles (road or highway);

3 - horse-drawn rolling stock;

4 - floating rolling stock;

5 - air rolling stock;

6 - rolling stock for funicular railways;

7 and 8 - (vacant);

9 - other.

On the level of "type" (group 7, sub-group 0), the rail rolling stock has the following groupings purpose of individual parts of rail rolling stock for various exploitation requirements):

0 - locomotives;

1 - passenger railroad cars;

2 - freight railroad cars;

3 - motor railroad cars;

4 - technical and special railroad cars;

5 - streetcars and motor cars;

6 - attached tramway cars;

7 - trolleys and small cars for technical and special transportation.

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Groupings from levels four to the last will be worked out on the basis of criteria designating the special properties of given collections of permanent media. For this we accept as criteria in grouping those characteristics which designate the value or the average (normal) period for use of permanent media, e.g., the type of power, the kind of construction, type of equipment, character or ability for production and service.

The mentioned average (regular) period for using permanent media, established experimentally, is of considerable significance; knowing on the basis of reporting notations the time for including a given object into the permanent media of an enterprise and obtaining the average usage time for the class of a given collection of objects from the nomenclature or else from appropriate tables, it is possible to

(1) compute the percentage of consumption for a given object in terms of the percentile ratio between the actual usage time for the object and the overage time of usage.

(2) compute the percentage of usage ability for a given object in terms of a percentile relationship between the time during which the given object will probably be used and the average period of usage.

It is obvious that the summation of the consumption percentage and the percentage of usage capacity for a given object equals 100.

5. Valuation of Quality of Permanent Media

While taking inventory for permanent media, the value of each object is established in two variations:

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(1) as the original value by which we understand the value of the object when in a new condition;

(2) as the actual value, taking into consideration the consumption, i.e., the value of the object at the time of inventory.

By original value we understand basically the cost of reproduction corresponding to these expenditures, which will have to be made in order to reproduce the given object in a new condition at inventory time. The original value in this sense is thus independent of the actual level of investments for the construction or purchase of the given object.

Various reasons contribute to the acceptance at times of other methods for establishing the original value. In the already described and illustrated partial inventory of permanent media by the PKP in 1950, unchangeable unit prices in zlotys from the year 1938-1939 were accepted in order to establish the original value. The average original value found in this manner, i.e., designated on the basis of unchangeable prices, was then recalculated and expressed in another column in terms of the current monetary system (i.e., in zlotys from prior to the monetary exchange of 1950), accepting for this purpose a multiplier of 80.

The evaluation of permanent media according to the cost of reproduction expresses therefore the quantity of investments necessary for a simultaneous substitution of the given permanent media by new media. Such an evaluation represents the basis for establishing the quantity of amortization deductions, but it does not present the real and actual value of permanent media or consider their usage.

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The value of each object, with a consideration of usage, is obtained by multiplying its cost of reproduction by the percentage of utilization capacity.

In the "Specification for Permanent Media," for purposes of the general inventory we will also list the so-called typical object; next to the name of this object, the following more detailed designation will be provided:

(1) unit of measurement;

(2) unit designating the basic technical characteristics of the typical object (e.g., the power of the engine);

(3) the price according to the catalogue of the typical object;

(4) data making possible the evaluation of the cost to reproduce other objects, entering into the composition of this same class, on the basis of characteristics decisive for the difference in the prices of these objects in relationship to the catalogue price of the typical object;

(5) estimated, average cost of assembly;

(6) estimated, average cost of transportation;

(7) probable, average time for using the object.

As far as the groups of buildings and constructions are concerned, a composition of the specification which differs in this aspect will be applied, because the evaluation of the reproduction cost will be implemented on the basis of the construction cost for the appropriate unit (e.g., one cubic meter) for objects with identical or related properties and useful characteristics. These two groups will not have applied to them either the average costs for transportation and assembly.

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The above cited directives on typical objects have as their purpose to enable or facilitate the evaluation of reproduction costs for those objects not listed in official price catalogues. Supplementary data placed next to the typical object namely permit us to establish

(1) the properties which essentially influence the difference between the value of the typical object and other objects, listed in the same class;

(2) the value of these characteristics on the assumption that the sum of values for basic properties of the typical object equals the cost of its reproduction.

The estimated, average cost of assembly and ultimately of transportation should basically be established in a percentile ratio to the value of reproducing typical objects or the weight of these objects.

6. Reporting on Permanent Media

Reporting on the inventorized permanent media is conducted most appropriately with the use of the cardfile system.

A separate card is entered for each object; it includes columns for inscribing data from the sheets listing the inventory.

To simplify the reporting of mass permanent media, we introduce for them cards of a different kind, namely group cards; we inscribe on the individual cards the objects in a sense of a uniform classification and which are grouped according to the same territorial characteristic, (i.e., found on the same line, section, etc).

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Changes related to the quantity or value of permanent media and which have occurred since the completion of inventory are introduced currently into appropriate cards and columns of the cardfile.

7. Amortization of Values of Permanent Media

Permanent media are consumed in the production process, during which the velocity of consumption in the individual instances deviates considerably from the average usage time for a given group of permanent media; this occurs at a rate depending upon the concentration of the production process, the manner in which it is used and maintained. The value of permanent media decreases continuously in this manner during the period of usage and transfers itself by degree to the manufactured objects of production. At the moment the service has ended, permanent media represent only a liquidation value (old material, scrap, etc). A rational economy requires that the useful capacity of permanent media will be kept up through purposeful maintenance, through repairs and major overhaulings, and also that permanent media completely used up be replaced with new ones.

Maintenance, current and average repairs are covered by the accounts of exploitation expenditures.

Media for reproducing permanent components of property that have been completely used up are collected as an appropriate amortization fund.

For this purpose the original value of a given media group should be amortized each year (decreased) by the amount corresponding to the average annual usage. Thus established amount of

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amortization should appear as so-called amortization deductions and be transmitted to the amortization fund for the reproduction of the given property components.

The level of the amortization deduction for the amortization of the original value of permanent media is computed in percentages of their original value according to the formula:

$$O_u = \frac{100}{T},$$

where O_u - level of amortization deduction toward the amortization of the original value of permanent media;

T - average period of usage for a given group of permanent media under regular conditions of exploitation, expressed in years.

The experimentally established average period for usage for a designated group of permanent media results from utilization in so-called "regular exploitation conditions," to which we include, in particular maintenance of usage ability for a property component by means of required repairs and capital overhauls.

Monetary media for major overhauling are collected in a separate amortization fund by means of a type of percentile computation differing from the original value of permanent media, and namely according to the formula:

$$O_{r\ kap} = \frac{I \times K \times 100}{T \times W_p},$$

where $O_{r\ kap}$ - level of deductions in percentage of the original value for the amortization fund on major overhauling;

I - number of major overhaulings per average utilization period of a given property component;

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K - cost of one major overhauling;

T - average time for usage of property components of a given group under regular exploitation conditions;

W_p - original value of the property component of a given group.

The level of the common amortization deduction, including deductions for amortization of the original value in permanent media as well as deductions for major overhauling, is computed in percentage of the original value for permanent media according to the formula:

$$O_{common} = \frac{(W_p + I \times K) \times 100}{T \times W_p} .$$

It should be noted that the preciously cited formulas do not consider the liquidation values for permanent media nor the liquidation expenditures.

Requirements connected with financing investments on a national scale have caused the level of amortization deductions to be standardized recently in a somewhat different manner.

The new financial system introduced by resolution of the Ministerial Council on 17 April 1950 also regulates the matter of financing major overhauling and investments. For a given branch of the national economy a general percentage of the amortization fund is established. The superior units are authorized to designate that part of the amortization fund which has been designed for capital repairs, in a percentage ratio to the entire amortization fund, for the individual enterprises subordinate to these units. Unused media in the amortization fund for major overhauling are basically transferred to the next year.

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The investments of state enterprises, foreseen in the investment plan, should be financed

(a) from the amortization fund remaining after designating a part for capital repairs;

(b) from the state budget;

(c) from unlimited media, defined in detailed regulations.

8. Statistical Compilations

Data included in the inventory lists and supplemented by current registration of changes with regard to the quantity or quality of permanent media make possible the elaboration of several statistical compilations describing and characterizing the equipment of enterprises from the point of view of permanent media. To obtain derivative numerical characteristics, it is necessary to subordinate the collected material to a grouping according to properties of value.

Statistical compilations have as the subject of their description and their characterization (a) the quantity and (b) qualitative structure (composition) of permanent media.

The first group includes primarily compilations showing the quantities of permanent media, computed in absolute figures or on the basis of designated dates, or else as average quantities computed for a given time period. In this second instance the average quantities are computed in terms of the arithmetic mean for the quantity of permanent media that exist at the beginning and end of a given time period; such a type of compilation in the form of a accumulation series, encompassing a period of several years, picture the changes in the status of equipment of permanent media during the individual years in the period.

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To emphasize the concentration of change, the series are also worked out with the assistance of dynamic factors, indexes, with a constant base as well as chain indexes, and in this connection the series compiled according to the method of chain indexes illustrate the changes in the tempo of growth. The elaboration of accumulation series, however, is conditioned upon the previous bringing of values for permanent media for the given years down to these same prices. In this instance the indexes will illustrate at the same time changes in the physical quantity for a given group or for all permanent media.

The above mentioned series may be worked out in different variations for the entirety of permanent media in the PKP enterprise or for the individual groups of property components for the purpose

(a) of a comparative evaluation of their relative growth tempo;

(b) of characterizing the equipment in permanent media as well as changes in the equipment either in the individual districts, the main lines, other first-class lines, designated sectors, etc (grouping in a territorial cross-section) or else in the individual services, etc (grouping in a functional-organizational cross-section).

Special importance and expression is acquired by the discussed compilations if the elaborations include periods of time which correspond with the periods over several years in the economic plans, characterizing in this connection the quantity of achieved results in the area of accumulating permanent media as well as the tempo of increase during the individual years of a multi-year plan.

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The same group of compilations, characterizing the amount of equipment in permanent media, should also include compilations on the average equipment in permanent media which are available per one kilometer of the individual lines and resulting from a division of the values for pertinent permanent media in zlotys by the exploitation length of a given line in kilometers. With the assistance of averages thus computed it is possible to characterize the reciprocal relationship of the individual districts, lines, sectors, etc, from the point of view of equipment level in permanent media.

The qualitative structure (composition) of permanent media is established by grouping the data on the value of permanent media according to a category classification, with a computation by percentage of the participation for the individual groups of permanent media in relationship to the whole.

Computation of the discussed characteristic quantities according to the original value of permanent media, i.e., on the basis of costs for reproduction, does not include greater difficulties.

On the other hand, if the data are to represent the real and actual value of permanent media, taking into consideration the degree of consumption, the computation may be based upon the so-called average percentage of usage capability for the permanent media. It should be recalled that the percentage of usage capability for a given object is the percentage ratio of the time, during which the given object will probably be used, to the average usage period; then the average percent of usage capability for a designated group of objects (or for all of the permanent media) will equal the

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percentage relationship between the real value of objects in a given group (i.e., with a consideration of usage) and the value according to reproduction costs. Thus we have nothing more than the arithmetic mean for the individual factors (percentages) of usage capability, weighed according to the reproduction value of the individual objects.

Computing the average percentage of usage capability for a given group of permanent media may, therefore, be based upon the following formula:

$$\overline{P} = \frac{\sum P C_o}{\sum C_o},$$

where $\overline{P}$ - average percentage of usage capability for the group of objects;

P - percentage of usage capability for individual objects;

C_o - costs for reproduction of individual objects.

Example. Among three freight cars, one has a reproduction value of 84,000 zlotys and 40% usage capability; another 54,000 zlotys and 50% usage capability; the third 74,100 zlotys and 70% usage capability.

The average percent of usage capability for all three freight cars amounts to:

$$P = \frac{40 \times 84{,}000 + 50 \times 54{,}000 + 70 \times 74{,}000}{84{,}000 + 54{,}000 + 74{,}100} = 53.07\%.$$

In the series of factors characterizing the qualitative structure, we should also include the so-called renewing factor for permanent media; this is expressed in percentage of the relative ratio between the value of new property components, obtained after

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the designated date or during a certain period of time, and the total value for all of the permanent media.

Example. The value of all permanent media on 1 January 1950 amounted to 203 million zlotys, of which the value of property components obtained after 1 January 1949 includes 11 million zlotys. The factor for renewing the permanent media during the period 1 January 1949 to 1 January 1950 was the following:

$$\frac{11 \times 100}{203} = 5.4\%.$$

The basis for computing the renovation factor for permanent media may also be represented by natural or physical units instead of monetary units. In this instance the computation must be limited only to groups of uniform objects which can be measured or expressed by the same natural or physical units (e.g., freight cars by loading capacity tons; buildings by cubic meters of volume; wooden railroad ties in units; etc).

9. Reporting

In 1950 the PKP conducted an inventory of permanent media in the production branch, and namely in the following units remaining on the internal economic cost accounting system: repair shops, road shops, electrotechnical, electrotraction, graphics shops, saturation stations, and ferry boats.

At present preparatory work has been commenced for a complete inventory of all permanent media in the service branch of the PKP enterprise.

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In connection with the above state of affairs reporting, refering to changes in the quantity as well as quality of permanent media, has been organized only in the production branch of the PKP enterprise as follows:

Bookkeeping for the units designated in the introduction, which remain on the internal economic cost accounting basis, registers the current changes in the quantity and value of permanent media on so-called "Specifications of Change No 1." Notations on the mentioned specifications are introduced on the basis of pertinent original documents.

The bookkeeping for the discussed units informs its district administration about the changes in quantity and value of permanent media only for annual periods with the aid of "Specification of Change No 2." This specification includes all current changes, which have taken place over a period of one year, as well as the decrease in the gross value (original value) for permanent media by the annual quantity of consumption and amortization payments, and the increase of the gross value by the quantity (value) of completed capital repairs.

Changes implemented on the basis of the Specification for Changes No 2 are indicated by the district administrations in an attachment to the annual balance sheet which serves the Ministry of Railroads in the preparation of an appropriate abstract compilation for the collective balance sheet.

As far as the service enterprise on the PKP is concerned, on the other hand, the net value of permanent media (i.e., considering the consumption) is reported in each district administration

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only according to the total completed evaluation. This is, of course, only a temporary stage until the time when the appropriate inventory can be conducted.

The current changes in the total net value of permanent media, resulting from investments, transfers, reclassifications, liquidations, are registered in the district administration on the basis of pertinent original documents.

During the transition period, therefore, we do not report the changes in the total value of permanent media in connection with the amortization deductions, usage, and major overhaulings; it is assumed in this connection that capital repairs represent compensation for usage.

CHAPTER VII. FINANCIAL STATISTICS

A. Introductory Comments

To implement the tasks resulting from the national economic plans, the appropriate agency head, after an understanding with the Minister of Finance and with permission of the State Economic Planning Commission chairman, will direct the opening of a state enterprise.

State enterprises possess a legal personality and are conducted according to the bases of economic cost accounting or as budget enterprises, the income and expenditures of which are encompassed by the budget of the state. The state enterprise of the PKP belongs to those enterprises conducted according to the principles of economic cost accounting.

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The media necessary for the implementation of planned tasks are assigned to the state enterprise at its creation by the appropriate minister upon agreement with the Minister of Finance and the Chairman of the PKPG. These media represent the foundation for the operational autonomy of the enterprise; they may be increased or else decreased in instances justified by economic plans.

The assigned media comprise the so-called "own fund" of the enterprise which includes the following:

(a) permanent media;

(b) own turnover media.

The prices for the transportation and dispatching services of the PKP enterprise are established for the binding tariffs as planned prices. Income, based upon the tariff prices, serves the PKP enterprise to cover own costs and the tax on nonfreight operations as well as management of a profit. With the mentioned tax on non-freight operations, PKP profitableness is regulated.

The transportation-fiscal activity of the PKP thus has a material basis upon the permanent and turnover media assigned to the enterprise. The main framework of PKP income is connected with the implementation, according to tariff prices, of the created transportation services; on the other hand the difference between income and exploitation outgo decides the attainment of financial results.

Financial statistics include therefore within their subject matter turnover media, income, exploitation expenditure, and fiscal results.

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B. Turnover Media

1. The Concept of Turnover Media

In the production process, as has been already mentioned in the foregoing, a man reacts with the assistance of labor devices (included among so-called permanent media) upon work objects in order to attain the planned production result. Work objects include especially raw materials, fuel, and other materiel. Work objects participate only in one production cycle, since they either enter into the composition of the manufactured product or else are consumed during the production period (fuel, greases, power materials, etc). The value of work objects enters into the composition of the value for a created product or services. The enterprise obtains a return for the value of consumed work objects through implementation (disposal) of its production.

Work objects create the basic framework of so-called turnover media. Turnover media also include production in process, prepared products, financial media, etc.

Turnover media, which are at the disposal of the enterprise, proceed along the route of their circular movement from one form into another whereby the sequence of this transformation is represented basically as follows:

the financial form (monetary), like payment media and reserves in the cash register or bank account, checks, etc;

the form of work objects, like raw materials, fuel, other materials and semi-manufactured items;

the production form, like work in progress;

the freight form, like completed production;

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the financial (monetary) form, manifesting itself after the implementation of the created production and ready to assume a new circular movement.

In transportation-dispatching enterprises the forms -- production as services in progress, and freight as completed service production -- amalgamate into one form, since the transportation-dispatching services cannot be produced for supply but are "consumed" at the moment of their creation.

Turnover media at the disposal of the enterprise are found at the given moment in different forms side by side; this guarantees a technological continuity for the production process.

The above indicated forms pertaining to turnover media may be divided into two fundamental groups, and namely:

(1) turnover media which are in the production process; the following belong here:

(a) materials, fuel, and inventory in supply as well as materials and fuel taken for production and still not completed;

(b) materials and fuel en route;

(c) tools and inventory in exploitation (usage), excluding objects included among permanent media;

(2) turnover media in the turnover process; this group includes the following: completed production (manufactured commodities or services produced, e.g., transportation) as well as media in financial form, like cash, bank accounts, checks, promissory notes, valuable papers, and various types of accounts.

Own turnover media (see Page 348), after each passing through the production process and the turnover process, return to the dis-

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position of the enterprise for an ultimate commencement of a new circular movement. The quantity of own turnover media is designated by the financial plan.

Of considerable importance for the method of financing is the division of turnover media into so-called standardized and nonstandardized.

The following turnover media are basically subordinated to the standardization process: basic materials, auxiliary materials, fuel, packing, spare parts for machinery and equipment, nonpermanent objects, commodities, manufactured products, production in process, semifinished products, remnants, as well as active inter-period accounting. The sum of norms, established for the individual components of the standardized turnover media, represents the total norm for turnover media.

The turnover media enumerated above (e.g., monetary media in a bank) are not subordinate to standardization.

The norms for the turnover media of enterprises should be covered in whole or in part by own funds or by liabilities constantly remaining within the turnover of the enterprise.

Newly established enterprises are assigned from the state budget own funds to cover the norms of turnover media.

Constant liabilities, utilized for covering the norms of turnover media, may be compared in terms of consumption possibilities with the own fund of an enterprise. Constant liabilities include especially the following:

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(a) regular indebtedness of an enterprise in relationship to its workers on the basis of compensation for labor after it has been implemented as well as regular indebtedness for social insurance;

(b) indebtedness of an enterprise to suppliers for bills;

(c) income for future accounting periods (pre-payments), etc.

Deficiencies in covering the normatives, which will appear at the beginning of the year in connection with the establishment of the plan or during the year as a result of an increase in norms due to the growth of planned economic tasks for the enterprise, are supplemented in part by the profit of the enterprise and if that is not sufficient then by means of an endowment foreseen in the state budget.

A surplus of own turnover media -- in relationship to the normatives -- should be paid into the state budget by the enterprise.

Satisfaction of temporarily increased requirements of the enterprise in the area of turnover media, if these needs go above what can be defrayed by own funds and by constant liabilities, takes place next by means of bank credits issued on the basis of appropriate categories, like:

(a) normative credits, designated to supplement own turnover funds in an enterprise as well as to credit the turnover;

(b) above-normative credits designed to finance the above-norm conditions of turnover media which have a seasonal character or which are connected with an overfulfillment of the production plan or the turnover as well as those resulting from other reasons;

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(c) collected credits, having their basis in the amounts due on invoices for completed deliveries, services, and labor;

(d) import and export credits as well as other credits with an appropriate nomenclature.

The organization of the circulation in turnover media is of tremendous significance to the enterprise since the efforts connected with supplementing the turnover media as well as the correct utilization of these media represent the preponderant part in the financial activity of the enterprise.

2. Norms of Turnover Media

On Page 350 we enumerated in particular those turnover media subordinate to standardization.

Standardized turnover media include primarily labor objects (raw materials, fuel, materiel). In the total sum of all turnover media, with which the PKP enterprise operates, a preponderant percentage covers labor objects, i.e., standardized turnover media.

The level of standardized turnover media is established by the financial plan of the enterprise in a sufficiently large sum, so that an effective implementation of planned production tasks for the enterprise will not experience any slow-down.

The level of nonstandardized turnover media, on the other hand, depends upon the enterprise itself, upon its financial-productive activity, and upon the status of accounting.

The structure of turnover media to be found in the production process differs basically in transportation enterprises from the structure of these media in enterprises producing material

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objects. In these latter ones approximately 45 to 62% goes for raw materials and basic materials, representing the main substance of the manufactured products. In transportation, labor objects do not enter into the composition of created transportation production; they are designated mainly for use during the transportation process (fuel, grease) or for other requirements of exploitation, and finally for repairs and the reconditioning of permanent media like rolling stock units, railroad tracks, etc.

In transportation enterprises the structure of turnover media located in the production process does not thus include any raw materials or basic materials whatsoever; on the other hand the participation of auxiliary materials (this also includes materials designated for the maintenance of permanent media), devices having little value, minor parts of the inventory, etc, and primarily fuels and grease, covers over 90%.

The level of the planned sum of turnover media, imperative for the exploitation activity of PKP enterprises, is established on the basis of the transportation-financial plan; the sum total of these media is directly proportional to the planned quantity of shipments, repairs, and overhaulings.

The principal framework of turnover media, found within the production process as well as within the turnover process, is located with reference to the PKP enterprise in the exploitation-production units; a smaller percentage of these media (between 11 and 47%), depending upon the type of materiel, is stored in the form of materials inside of warehouses.

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The individual groups of standardized turnover media have established norms; their significance corresponds to the warehouse normatives, of course from the monetary point of view.

The task of standards is to

(a) designate the quantity, i.e., the supply of a given group of turnover media, which is sufficient for guaranteeing the continuity of the production process;

(b) counteract the surplus collection of turnover media.

The immobilization of social values by creating surplus supplies of turnover media slows down the direction of these values into different forms or for the satisfaction of other requirements; it especially restrains the implementation of a more extensive reproduction.

It should also be noted that by operating with smaller amounts of turnover media we will save on labor and on expenditures connected with storing materials, sorting them out, reporting, etc.

It is know from the statistics of materials (see sub-chapter on "Standards of Supply") that the warehouse norm may be expressed as the

(1) planned average status of the warehouse supply for a given material in a natural framework;

(2) the number of calendar days during which the warehouse supply should last.

Similar importance is attached to norms for turnover media, but the latter operate only in a monetary framework, not in a natural one. In this meaning standards are a planned directive,

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designating the monetary value for the average status (supply) of a given part of the turnover media necessary for guaranteeing the continuity of production.

The norm for turnover media in the monetary framework is thus established for each part (group) among the turnover media on the basis of a plan for exploitation expenditures as well as the supply standards designated for the given part of the media during calendar days. For this the planned annual expenditure in a given group is divided by 360, and the product obtained is multiplied by the established norm for supply which is expressed in days.

Standards are not established for the following parts of turnover media: (a) for monetary media and (b) for unfinished accounting with recipients and suppliers.

The level of the norms is established at the end of the planned period, e.g., standards for the first quarter are set up on 1 April; as a result this day becomes like the introductory norm for the period of the second quarter.

Standards, like all supply norms, are not and cannot become constant quantities.

Changes in the level of standards are primarily the result of

(1) increasing or decreasing production quantities during the individual months or quarters of the year, in the course of which also the level of expenditure (turnover) changes correspondingly for a given part of the turnover media;

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(2) changes in the supply norms, expressed in calendar days.

The standard for turnover media is computed with the assistance of the following general formula which takes into consideration the previously discussed factors:

$$N_{so} = \frac{W \times N_z}{H},$$

where N_{so} - standard for turnover media which have been standardized;

W - expenditures according to the plan for exploitation outgo in a given part of turnover media during a planned period;

N_z - supply norm in days for a given part of the turnover media;

H - length of the planned period of time in days (30 - 90 - 360 days).

The standard for a given part of turnover media is essentially the planned average supply in a monetary form. For reporting or for control as to the degree to which the actual supply corresponds to the planned directive, it is sufficient for the given part of turnover media to compute the average balance on the accounting books (average remainder) during the reporting period. The percentage relationship of the book balance and the norm represents the sought after factor on the degree of implementation of the planned task with regard to the norm.

If all organizational units in PKP enterprises are bound by the same number of calendar days of warehouse supply for a given part of the turnover media, there will be no obstacles in the path of computing the pertinent standard for the entire enterprise as a whole; in this connection, the value "W" in the previously indicated formula will be the sum of the appropriate expenditures for all organizational units in the enterprise. The percentage factor,

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characterizing the degree of implementation in relationship to such a collective norm, may be computed by summing up the appropriate averages in the book balance for all organizational units in the enterprise during the reporting period and dividing the compiled sum by the total standard.

The norm for part of the spare parts necessary for repair and rebuilding as well as the standard for inventory of little value and of short duration is established as a rule only in terms of value and not according to the supply in days. The standard for spare parts is computed in this connection in terms of groszy per one zloty of average annual value of the corresponding production equipment, machinery, rolling stock, etc. The norm for inventory of little value or of short duration is established depending upon the composition and types of these objects, the number of employees, the amount of machinery, rolling stock, or other equipment. Establishment of a supply in days would be, under the above circumstances, a very complicated matter and would not always provide accurate quantities in connection with the complex organization of railroad transportation.

3. Speed of Circulation in Turnover Media

The speed of circulation, also known as speed of circular movement, speed of turnover, rotation or revolving of turnover media, represents the velocity with which turnover media pass from one form to the next in their circular movement.

A speed-up in the circulation of turnover media, i.e., shortening the time during which they remain in an unchangeable form before passing into the next form, e.g., from a monetary form into labor

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objects, etc, is of considerable significance for the interested enterprises and for the entire national economy.

Shortening the time during which the turnover media remain in the individual forms permits namely the creation by the enterprise of the same amount of production with a smaller quantity of turnover media; the released part of the turnover media, in this connection, may be utilized within the framework of the national economy as a social value for other production purposes or within the area of the same enterprise for the expansion of production.

In the service branch of the PKP enterprise the productive form of turnover media as work in progress usually lasts very briefly; the freight form, however, in terms of completed production is completely eliminated. As a result, the turnover media from the monetary form are transfered into the form of labor objects (supplies of fuel, materials) which after consumption in the course of production again pass on into the monetary form as income from completed transportation or dispatching services.

The problem of hastening the circulation of turnover media in the PKP enterprise thus requires special attention focused on the speed up in the circulation of media situated within the supplies of materials and fuels as well as within the accounting for implemented services.

For this, the established standards for these parts of the turnover media cannot be treated as unchangeable quantities but should be systematically checked and corrected from the point of view of hastening the circulation of turnover media.

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The velocity of turnover for the sum total of turnover media or for the individual parts of the turnover media is expressed by the quantity of turnovers during the reporting period as well as by the duration of one turnover in days.

The factor for the number of turnovers, completed during the reporting period by a given part of the turnover media which are in a designated form, is computed according to the formula:

$$O = \frac{W}{S},$$

where O - number of turnovers during the reporting period;

W - the sum of expenditure (turnover) in the books on the account of a given part of turnover media during the same period;

S - the average remainder (average balance) on the account of the given part of turnover media also during this same time.

In the above formula the value "O" is a relative quantity which characterizes the relationship between two comparative quantities of one type. The computation indicates how many times the amount of the average balance should be "turned over" in order to obtain the book sum for the expenditure of a given part of the turnover media.

On the basis of the above formula, we also compute the planned number of turnovers for a given part of the turnover media; in this instance

W - represents the planned expenditures for exploitation of a given part of the turnover media during a planned period;

S - represents the standard for a given part of the turnover media (planned average supply in monetary form).

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The factor for the quantity of completed turnovers during the period being reported upon by all turnover media in an enterprise taken together, regardless of form in which they are situated at this time, is computed according to a similar formula and namely:

$$O = \frac{K}{S},$$

where O - number of turnovers during the period for reporting;

K - sum of own costs implemented during the period for accounting of the service production, computed according to actual own unit costs, and in case of a lack of computations according to the own planned unit costs;

S - average sum of balances for all turnover media resulting from such balances as financial media, amounts due, materials, fuels, production, and services in progress as well as unfinished accounting.

To compare the resulting quantity "C" with the planned quantity, it is necessary to compute "K" (i.e., the total of implemented production or services during the reporting time) according to own planned unit costs; if this is not done, different types of quantities will be compared.

In the USSR, by circulars of the Finance Ministry and Central Statistical Office in 1949, it was urged that the number of turnovers completed during the reporting period by all enterprise turnover media be computed differently and namely:

as "K" - to accept the total, implemented during the reporting period, of production at wholesale prices of disposal with exclusion of the turnover tax.

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An increase in the number of circulations (acceleration of the circulation) for turnover media thus precipitates not only a decrease in the average total for active turnover media in the enterprise (i.e., "S") but as a rule also the lowering of own unit costs; the latter also causes a decrease in the total of completed production, computed on the basis of own unit costs (or "K"). In view of the simultaneous decrease in the quantities of "K" and "S," the number of turnovers resulting from the method for computing the total of implemented production according to own unit costs is not formulated advantageously for the enterprise.

The method for computing all turnovers, recommended by the above indicated circular, thus aims to eliminate the foregoing deficiencies which may represent an obstacle in the action of decreasing own unit costs. The acceptance for purposes of computation as "K" the sum for implementing production according to disposal prices may indicate a considerable increase in the velocity of circulation also should own costs have undergone a decrease.

As "S" we accept the average sum of balances from all turnover media which results from the balances, with the exception of the average sum of monetary media found within the operational bank account. The exclusion from "S" of that part of the turnover media has from one aspect the purpose of throwing light upon the acceleration of circulation which results from the fluidity of above-norm supplies in materials, works in process and finished production; on the other hand, it is considered that the monetary media on the operational account increase the bank funds and enable the financing of production in other enterprises.

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The method applied in the USSR for computation of the speed in turnover media has recently been recommended also in our periodicals. It should be mentioned that in the USSR itself this method has its antagonists who fight it because they think it is contrary to theoretical assumptions and manifests considerable deficiencies also in practice.

To compute the factor for the number of turnovers completed during the reporting period by all turnover media of an enterprise taken together, the following formula is also in use:

$$O = \frac{S}{K} .$$

It represents the reverse of the previously discussed formula and expresses the quantity of turnover media per one zloty of implementation. It indicates the amount of turnover media utilized during a given period being reported upon and used for the attainment of one zloty worth of completed production (services).

The time of duration for one turnover in days. With a given number of turnovers implemented by the turnover media during the reporting period (or planned period), the time of duration for one turnover in days is established with the assistance of the following formula:

$$d = \frac{H}{O} ,$$

where d - time of duration for one turnover in days;

H - length of reporting period or planned period in days (30 - 90 - 360 days);

O - number of turnovers during a given reporting period or during a planned period.

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The time of duration for one turnover in days for a given part of the turnover media may be established without the necessity of a previous computation of turnover quantities during a given period, and namely with the help of the following equation:

$$W : S = H : d,$$

where the symbols W, S, H and d have the same meaning as that which has already been given.

Therefore, $$d = \frac{S \times H}{W} .$$

When using the above formula to compute the time for the duration of one turnover in days by all turnover media in an enterprise taken together, it is necessary to use the quantity "K" in place of the quantity "W" and consider the reservations previously given.

The above mentioned equation presents us with the advantage that, when we know the values of any three symbols, we can easily compute the unknown value of the fourth symbol in the equation. Thus it is possible especially to compute the needed sum of a given part of the turnover media in case of change in the time of duration for one turnover in days, and namely:

$$S = \frac{W \times d}{H}$$

or when computing the sum for all turnover media in an enterprise taken together:

$$S = \frac{K \times d}{H} .$$

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4. Reporting and Statistical Compilations

Periodic financial statements, discussed in more detail in sub-chapter "F" of this chapter, include numerical data in monetary terms on the turnover media of an enterprise according to the status at the end of the month being reported upon.

These data designate

(a) the quantity of turnover media and their structure (composition) according to individual forms;

(b) the distribution of turnover media, and namely their division among organizational units which remain on the internal economic cost accounting system.

When preparing statistical compilations on the basis of the above indicated numerical data, one must remember that in connection with monetary media we are dealing with mass phenomena rapidly changing their concentration in time with regard to designated average statuses and thus not accumulating as happens with permanent media. Therefore we take into account only dynamic series, and in statistical compilations which encompass an annual period considerable significance is attached to the acceptance of monthly divisions. In view of the close connection between the quantity and the structure of turnover media as well as the quantity and quality of transportation production, compilations in terms of monthly divisions make the appropriate analysis much easier.

The directives in the section concerning statistical tables on equipment in permanent media also have appropriate application to statistical compilations encompassing turnover media.

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The monthly financial statements also include numerical data enabling us to compute the number of turnovers completed during the reporting period by a designated part of the turnover media or by all turnover media of an enterprise taken together, as well as to compute the duration in time for one turnover in days.

The resulting quantities computed in this manner provide an appropriate picture of the economy of turnover media only in a compilation with the appropriate planned quantities.

Progress achieved in the management of turnover media is divulged by tables in which the mentioned resulting quantities are compiled for a series of reporting periods, especially those belonging to the same period of a multi-year plan.

C. Incomes

1. The Concept of Income and Its Structure in the PKP Enterprise

The incomes of the PKP enterprise, also called implementation, are divided into operational income and extra-operational income.

Operational income is the sum of monetary media obtained as a result of the exploitation activity from

(a) payments for transportation and dispatching services, especially for the transportation of passengers, baggage and express shipments, freight, postal consignments, economic shipments as well as economic trains;

(b) payment for services indirectly connected with transportation as well as for reimbursable services, like telegraphic payments, for warehouses and storage payments, for advertising, etc.

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Incomes from outside of operations include income from activity beyond the shop (like income from rental objects, rents for housing as well as from buildings rented to commerce and industry, other rental payments, etc) as well as income from the sale of materials.

The most important for the PKP enterprise of course are the incomes from payments for transportation services.

The task of reporting and statistics in the area of incomes is the elaboration of materials necessary for the control and analysis of executing the plan for implementation. The indicated statistical tasks require certain introductory remarks as to the moment for implementation and division of incomes among district administrations.

The sender is responsible for taking upon himself payment for the charges to cover transportation of the shipment; the dispatching stations collect these payments. In this manner reporting on the income level from the transportation of consignments is connected with the conclusion of pertinent transportation agreements. The amounts due along the route and at the end station (e.g., for the standing of cars) are collected from the recipient of the shipment by the terminal station in return for a receipt on various charges.

Also the income from the transportation of passengers is taken up basically at the time the tickets are issued and appropriate reporting is connected with this moment. Only in the transportation of various shipments on credit does the cash income deviate from the reporting moment.

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For an efficient implementation of service and exploitation activities by means of railroad transportation does the PKP enterprise organize itself into independent territorial units (district administrations) operationally which also fulfill the functions of reporter for the given district.

If the designated transportation is implemented by only one district administration, i.e., within the limits of its territorial reach and by means of its media, an accounting of income due and also that which has been accepted in cash from transportation to the benefit of a given district administration does not arouse any reservations.

If however two or more district administrations participate within the designated transportation, as frequently happens in the field of railroad transportation, the problem arises as to the degree to which they will share in the income from a given shipment. This income, which has been accepted by the district administration corresponding to the dispatching station for the consignment and which has been encompassed by the reporting of the former, cannot be the exclusive income of a given district administration: thus by income of a district administration we can only understand that sum which belongs to it for completed transportation work by it.

Partition of the income from transportation among the interested district administrations was conducted by the Ministry of Railroads until the end of 1952 during monthly periods in the form of so-called factorial incomes; these incomes were computed by multiplying the axle-kilometers and the dispatching-receiving units completed during the reporting period by the individual administrations

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by their own planned cost. Payments were made from the central transportation accounting office in which the total of all transportation income from the entire PKP network were concentrated.

The appropriate level of income from transportation is not thus directly proportional to the quantity of implemented transportation work (e.g., to completed axle-kilometers). The level of income depends directly upon the realization (disposal) of transportation production; in this aspect, appropriately to the content of agreements made for transportation, the mentioned realization of production is computed on the basis of tariff criteria. It is therefore sound to have the income from transportation divided among the individual administrations in proportion to the degree to which they have actually contributed to making this income. Such a division of income at the same time will contribute to an increase in labor efficiency and to a decrease in own costs.

Since 1 January 1953 a new system of dividing transportation income has been in force which corresponds to the above assumptions and is based on the following principles:

(a) local communication

income from transportation completed exclusively within the borders of one's own district is received by the given administration in its entirety;

for activities by the dispatching and terminal stations, transit payments include a special station fee which is split in half between the dispatching and terminal administrations;

for activities connected with the dispatch of a passenger, a special manipulation fee is charged for the trip and laid aside for the administration in which the passenger was dispatched.

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After subtraction of the manipulation and station fees the division of the remaining payments for transportation taking place in direct communication, i.e., between stations in different districts, may be implemented by many ways with application to a smaller or a larger degree of various statistical-mathematical methods.

Since 1 January 1953 the PKP divides income from direct internal communication on the basis of the accounting statements submitted by ticket offices and dispatching freight offices. This is justified because passengers as well as those sending consignments are bound to make the transportation payments at dispatching time, and thus dispatching stations know not only the level of accepted transportation payments but also the transportation direction; this direction is indicated on the tickets issued, and in connection with consignments the dispatching station is obligated to indicate the direction on the transportation lists in accordance with binding directional rules. Thus there are no essential obstacles to prevent the insertion of all elements, which would be necessary to the administration for the correct division of incomes from transit, into the mentioned accounting statements.

Each district administration (financial bureau) executes the pertinent accounting for dispatching stations subordinate to it during monthly periods.

The income from reported tickets (after deduction of manipulation fees) is apportioned in each individual report into portions for the dispatching administration, terminal administration, and possible for the administrations in transit, in

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proportion to the distance covered within these administrations; the allotments are not apportioned individually in this connection, i.e., separately for each sold ticket but in total for all sold tickets on a given statement; this greatly accelerates the accounting activities.

Income from the ticket printing machines is divided among the individual district administrations in the percentage ratio which results from the division of income at other ticket windows in the same stations, which have sold ticket statements within a comparable extent to that of the printing machines. If the station has ticket offices exclusively with printing machines, the income from these printing machines must be divided in a percentage ratio to the results from all ticket windows in the district; whereas the amounts due from blank tickets of the regular type are divided in a percentage relationship to the participation results for ticket statements.

Amounts due from the transportation of consignments (loads) in direct internal communication is divided by the dispatching administration into income for the individual participating district administrations for the two following stages:

a. Supplementation of Specifications for Dispatched Shipments. In this stage, the supplementation of shipment specifications is done by the Finance Bureau of the administration; the specification had been prepared before in the dispatching offices of one's own district separately for each terminal administration, and the level of accepted transit fees is inscribed into one of the four columns designated for express, regular, economic, and other shipments; the

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mentioned supplement to the specifications are based on the fact that each shipment has computed its run according to the indicated (planned) transit direction as well as the distance and run in the individual participating administrations. Numerical data on the weight, total run, and level of transportation fees charged as well as on the run in the individual administrations are all totaled.

b. Computation of Shares. The sums from the above indicated specifications for each station and ticket office are transferred next as separate lines into a different abstract specification; on the basis of the established total weight for all shipments, we compute station fees which amount to 1.70 zlotys per one ton and deduct from the transit costs for regular consignments. In the individual lines, each type of transportation is divided by the completed run in order to obtain the average stake in the income (per one ton-kilometer); the computed stake is then multiplied by the participating run for each administration to obtain its income from shipments encompassed by a given line.

The inscribed partial results are finally summed up, whereas the total results from the dispatching and terminal administrations are increased by half of the level in station payments due to them.

The above mentioned fragment in the total picture of computation attests simultaneously certain inconveniences which arise from the division of incomes on the basis of accounting statements by the dispatch stations. The method and technique of computing is rather complicated and labor-consuming; calculations based on the material of departure, originating in the dispatching offices, cannot take into consideration at all the numerous deviations which manifest themselves in practice during the transportation of consignments in relationship to the transit route indicated by the dispatching station.

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The initial material for a division of income from the shipment of consignments on USSR railroads is the transportation list, i.e., the document including in particular data about the planned as well as the actual route for transporting shipments. Pertinent computations, based on these lists, are indubitably more accurate in comparison with those previously discussed; this method could not be applied for the time being by the PKP due to a lack of the necessary number of appropriate machine aids for accounting.

In the division of income from transportation of consignments among the participating administrations, it is also possible to apply the representation method. In this instance, we divide accurately only a part of the transportation lists selected so that they create the appropriate sample which would correspond to the scientific directives of statistics; the results thus obtained, refering only to a part, are then generalized for the entire amount due for the transportation resulting from the shipping lists during the investigated reporting period. The described method, submitting to an accurate accounting manipulation only a small part of all investigated transportation lists, should not necessitate the spending of large sums for accounting as is true of the previous methods. It should be mentioned that the PKP has not as yet introduced a practical means of checking whether the division of income from the shipment of consignments by the representative method actually guarantees accuracy of results to the desired degree.

2. Reporting

In accounting statements submitted to the district administrations, including a compilation of income from transportation as well as from supplementary tariff payments, it can be seen that

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the incomes appear as separate positions just as they originate from appropriate transit documents.

As a result of further control work, the initial basis for the reporting in separate positions of income loses its significance since the quantity of income is not dependent upon the number of positions of income but upon the sum of obtained zlotys.

Basic material, from which reporting data are received concerning the income from transportation, is the following:

(1) from the field of consignments, transportation documents or their copies, like transportation lists, etc;

(2) in the field of passenger transportation, appropriate notes by official ticket offices, like the daily book for ticket sales, the specification on blank tickets issued, the bill for tickets sold from the printing machines, etc.

Basing reports upon the individual positions of income has the following justification:

(1) Reporting units add to the prepared specifications proof in their possession, establishing that the data in the individual positions on the compilations correspond with the actual state of affairs; such proofs include e.g., backs or blank ticket stubs. As control material within the field of freight consignments, the dispatching administrations receive from the terminal administrations after the completion of the transportation lists from transit letters.

(2) In each position of income, a number of characteristics are registered which enables the elaboration of a collective characterization for the obtained income.

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In statements on the transportation of passengers by railroad, we include, e.g., such characteristics as the type of train used for the trip (express, passenger), the class of car, the tariff applied (regular, reduced), transportation distance in kilometers. In the statements on freight transportation the reporting period, type of consignments (regular, express), weight of shipment, number of units and area of the car occupied by small loads of live animals are all indicated. In each of the compilations, the most important characteristic indicated is of course the level of monetary income from a given position.

Reporting compilations are prepared separately for income from the transportation of passengers, baggage, express consignments, freight.

The above compilations are submitted by reporting units to their superiors in the district administrations, which in turn after the implementation of control communicate data on the incomes to their supervisory authorities in the form of abstract statements.

3. Analysis of Incomes

Neither the amount of income, expressed in absolute figures, nor even the percentage factor for the implementation of the income plan provide by themselves a sufficient basis for a characterization of results attained by the district administrations which results are connected with the implementation of planned incomes. For such a characterization, it is necessary to analyze how far the individual types of work in transportation have contributed to the achievement of the attained income and how much influence was exerted upon the degree to which the planned income has been implemented.

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The suggestions for such an analysis given below are based upon the collective work of authors J. Kochetova and others, entitled Zheleznodorozhnaya Statistika, Moscow, 1939.

Considering that the attainment of planned income within the transportation-financial plan is closely connected with the execution of planned transportation production, the analysis discussed here must oppose the quantity of obtained income to the quantity of implemented transportation production. Through such a contrast we receive as a result the average rate of the income which applies to a unit of completed production according to the formula:

$$D = \frac{D}{\sum pl},$$

where d - the average rate of the income;

D - the general sum of income from a given type of transportation;

$\sum pl$ - implemented transportation production for a given type, e.g., the number of ton-kilometers for freight shipments, the number of passenger-kilometers, etc.

If the quantity of the realized income differs from the planned income, with a simultaneous agreement as to average rates of income, i.e., planned and final rates, then the reason for such a deviation must be the difference between the quantity of planned and implemented transportation production.

The quantity of the attained income is influenced not only by the quantity of transportation production, but also by the degree of income capacity from this production. If we thus ascertain the deviation of the average rate in the resulting income from the planned rate, this can be the sequence from:

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(a) a change in the structure of transportation and especially in the changed numerical relationship between the number of passengers or the quantity of consignments transported according to tariffs which are higher or lower;

(b) changes in tariff introduced in the meanwhile;

(c) changes in the average transportation distance in kilometers; it is well known that in case of a lengthening of the average transportation distance, with a simultaneously existing differentiation in the construction of tariff rates, a relatively smaller transportation fee will apply per one kilometer of average transportation than per one kilometer of the same for shorter distances.

If the deviations from the average rate in the income from the planned rate have been caused by the total reaction by two or all three of the above indicated factors, then the task of analysis will be to indicate to what degree the established deviation should be attributed to each of these factors. The process of analysis runs so as to designate successively the influence of only one factor, assuming that the remaining ones have not reacted at all to the deviation of the average income rate.

To establish, e.g., how the degree of change in structure for transportation have influenced the established deviation, it is necessary to compute the average income rate for the reporting period with unchangeable (planned) tariff rates and then to divide this by the average income rate planned for that period; as a result of this action, we will obtain the relative figure (factor), picturing the sought after degree of deviation as a result of structural changes alone:

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$$o = \frac{d_o \, pl_1}{pl_1} : \frac{d_o \, pl_o}{pl_o} = \frac{d_o \, pl_1}{d_o \, pl_o} \times \frac{pl_o}{pl_1},$$

where o - deviation of the average income rate (sought after relative figure);

d_o - average planned rate of income;

$\sum pl_1$ - actual number of runs during the period being reported upon;

$\sum pl_o$ - planned number of runs.

If not only changes in the structure of transportation but also tariff changes have influenced the deviation of the average income rate during the reporting period, then the result of the action by tariff changes alone will be expressed by the factor:

$$W_t = \frac{\sum d_1 \, pl_1}{\sum d_o \, pl_1},$$

where W_t - designates the tariff factor for the deviation of the average income rate, i.e., the average quantity for tariff changes in two comparable periods;

d_1 - designates the average rate in the resulting income during the reporting period.

The tariff factor of deviation is thus the relationship between the total income from a given type of transportation during the reporting period and the sum of income resulting from the extent of transportation production during the reporting period but computed according to the average for the planned rate of the income.

Own unit costs for transportation media decrease together with the increase in the average transportation distance. This

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fact is also taken into consideration during the preparation of tariff rates, since the tariff fee per one kilometer of short distances is usually much higher than the similar fee for longer distances. The level of tariff fee per one kilometer does not decrease, however, in proportion to the growth in the transportation distance.

Similarly the matter of deviation from the average income rate in case of the shortening or lengthening of the average transportation distance in kilometers. The change in the average transportation distance for the entire transportation mass may be the result of a shortening or a lengthening of the transportation distance for low tariff shipments, which will deviate the average income rate only slightly. It may also be the reverse, however, if the shortening or lengthening is applicable to the transportation of high tariff consignments.

In view of the highly complex character of deviations from the average income rate, depending upon the changes in the average transportation distance, the expression of degree of deviation by an appropriately constructed mathematical formula which could be applied to each instance is practically impossible.

4. Statistical Compilations

Among the more important statistical compilations in incomes, we should indicate above all the tables representing:

(1) the dynamics of incomes over a period of several years:

(a) in absolute figures, i.e., in monetary units;

(b) in factors of the dynamics (indexes), accepting the total sum of incomes during the first year of a given multi-year period (year of departure) as being 1.00 or 100;

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(2) the quantity of income from a given type of transportation in comparison with the amount of pertinent transportation production as well as the resulting average rate of income; if compilations of this type have been worked out over a period of several years, then their dynamics should be expressed in absolute figures as well as in factors of the dynamics (indexes);

(3) the structure of incomes for a given annual or multi-year period in the compilation with a planned structure; in connection with compilations for an annual period, it is necessary to utilize absolute figures and factors of structure, in compilations over a period of many years, also factors of dynamics.

D. Exploitation Expenditures

1. The Concept of Expenditures for Exploitation

In general we call exploitation expenditures the outgo of the transportation enterprises, connected with production-transportation activity.

From the point of view of structure (composition), expenses for the exploitation of railroad enterprises encompass the following four basic groups of expenditures:

Expenditure Group	Participation in Total Sum of Exploitation Expenses in Percentages
(1) Compensation for work together with social expenses	about 50%
(2) Expenses for used fuel, materials, electric power, etc, for purposes of traction, repairs, and others	about 30%
(3) Amortization deductions from the total sum of permanent media with significance to production	about 15%
(4) Various expenses	10%

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The above figures, pertaining to the participation by percentage of the individual expenditure groups within the total sum of expenses for exploitation, should be treated as orientation figures. The relative quantity of these expenditures differs for the individual railroads.

In view of the very complex nature of production-transportation activities, it is impossible to include certain of the exploitation expenditures in a decisive manner within one of the groups indicated above under 1 to 3; expenses of this type are included therefore among so-called various expenses. This last group comprises, e.g., expenses for "foreign" work (services) implemented for the railroad enterprise by other enterprises.

Railroad enterprises have a relatively insignificant influence on the formulation of their incomes. The quantity of transportation depends upon the transportation requirements of the national economy and is established by state transportation plans; the level of tariff fees for transportation is formulated on the other hand by factors superior in dependence upon accepted assumptions of the economic policies of the state.

Under such conditions, the basic duties of a railroad enterprise within the field of exploitation expenditures are limited to

(1) the compilation realistically of a plan for incomes from exploitation in agreement with data from the transportation plan and the level of binding tariffs which are essentially planned prices for transportation services;

(2) striving toward an accurate implementation of the plan for incomes (realization).

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The authorities in a railroad enterprise on the other hand possess complete operational freedom to formulate the level of exploitation expenses by the enterprise within the limits of binding regulations (like the right to work, collective labor agreements entered into, tax regulations, etc) as well as within the limits of binding prices for materials and services. The statistics of exploitation expenditures cannot therefore limit itself to a passive registration of expense levels and their grouping according to structure, place of origin, etc, but should also prepare material for investigation of the purpose for expenditures and especially their exploitation effect resulting from the comparison between the quantity of expenditures and the amount of completed transportation production.

A further task of statistics on exploitation expenditures should be the supplying of statistical data necessary for conducting an accounting as well as an analysis on the implementation of the plan for own costs.

The statistics of exploitation expenditures, therefore, assumes an important and active part in the struggle for savings, for lowering own unit costs, and for an internal mobilization of transportation reserves.

2. Statistical Material

The statistics of exploitation expenditures, like income statistics, is not based on a separate kind of material collected along the way by a statistical observation system specially organized for this purpose. The documents, used by statistics of exploitation expenditures, are utilized simultaneously for other needs and thus

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represent statistical material also for the remaining branches of railroad statistics as well as for accounting purposes.

The foregoing documents have the character of either primary source material for accounting or else of current bookkeeping documentation.

The basis, e.g., for a list of wages or for other compilations regarding payment for work, for payments of various increments, premiums, etc, is that type of primary materials such as lists of those present, daily work books, labor specifications for locomotives, route cards, etc, in brief documents primarily designated for employment statistics, rolling stock labor statistics, etc.

On the other hand expenditure proof, comprising the basis for registering and entering into the books the outgo of materials, is the expenditure assignation issued by the warehouse on the basis of a requirement for material and an order to release the materials. The requirement for material, which is issued by the organizational unit that requests release of the material by the warehouse, is a document serving primarily the needs of storage reporting in the field of materials' turnover.

Expenditures connected with the purchase of materials, fuel, etc, do not belong to exploitation expenses; these purchases serve to complement the supplies and are entered into the books under chapter XI on the Branch Plan of Accounts. The object of exploitation expenses can include materials, fuel, etc, only when issued by the warehouses for the purpose of consumption.

A primary accounting source material in the area of foreign work and services implemented for the railroad enterprise is

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represented by various kinds of agreements, bills, etc. Each of these documents should include all of the required data, designating the source and recipient of the order, the object of work or services, its economic purpose, the time and place of implementation and the price or other indications which would establish the level of payment.

Exploitation expenditures are characterized by the property that the moment of cost accounting is connected with the implementation of work or services or the receipt of materials, but it does not correspond with the moment of actual disbursement, and thus provides the basis for the establishment of so-called constant liabilities which are used to cover the standards of turnover media; the payment, e.g., of compensation for work and services completed during the month of December must be included in the accounts for the month of December also in cases when the actual disbursement took place in January of the following year.

3. Grouping Expenses by Category

In force since 1 January 1953, the Branch Plan of Accounts in the service branch of PKP enterprises does not foresee the bookkeeping formulation of expenditures in a separate chapter according to category composition as was done, e.g., by the preceding Uniform Plan of Accounts which designated for this purpose class 4. Grouping by types of expense is applied, however, in accounting own costs both planned and resulting; in this connection we assume a division of expenditures according to the following category groups:

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Payments with extras

including the wage fund

anonymous wage fund

social security payments

social insurance

prizes

Fuel

including coal for traction purposes

Remainint materials

Electric power for traction purposes

Amortization deductions

Remaining expenditures.

4. Accounting of Own Costs

The railroad, like every other socialist enterprise, systematically conducts a so-called accounting of its own costs. This accounting includes primarily the basic production of the railroad, i.e., the transportation of freight and passengers as well as dispatching services.

The purpose of the discussed accounting in the planned economy of railroads is above all the reporting on the implementation of planned tasks pertaining to the lowering of own costs of production.

The accounting of own costs in principle is based upon the appropriate grouping of planned or resulting expenditures, and namely upon the dependence of each position in the expenses with regard to the appropriate type of production pertinent to the given expenditure. In this manner we obtain the entire (global) costs for the individual types of production.

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In railroad transportation, we have accepted the computation of own costs separately for passenger traffic and separately for freight traffic (categories of production) with the following further grouping:

a. in passenger traffic:

transportation of passengers;

transportation of baggage and express shipments;

transportation of postal consignments;

b. in freight traffic:

transportation of shipments in freight trains;

transportation in economic trains.

In practice only so-called direct costs may be transferred without further calculations to a given type of traffic. Such direct costs include, e.g., in passenger traffic the costs of maintaining teams of conductors, repair costs; cleaning, inspection, heating, lighting, and greasing costs in passenger cars; costs for maintenance of ticket offices and cashiers, etc.

Other so-called indirect or common costs do not pertain decidedly to one type of traffic only and therefore must be submitted to the appropriate calculations among those types of traffic with which they are connected. Such calculation takes place with an application of the corresponding keys with which measurements or percentage ratios may be designated.

Dividing the total costs for a given type of traffic by the quantity of units completed in this branch of production, we obtain the unit cost which represents the cost of an implemented unit of production.

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Unit costs are computed in passenger traffic (in whole numbers) per one train-kilometer, one car-axle-kilometer, and one ton-kilometer gross. In relation to the previously given grouping of passenger traffic we also compute the unit costs:

for the transportation of passengers -- per one passenger-kilometer;

for transportation of baggage and express consignments -- per one ton-kilometer;

for transportation of mail -- per one car-axle-kilometer of post office cars.

Unit costs in freight traffic are computed per one train-kilometer, one car-axle-kilometer, and one gross ton-kilometer without regard as to whether the matter pertains to the entirety of freight traffic or to the individual groups in this traffic like the transportation of shipments in freight trains or in economic trains. The transportation of loads in freight trains is computed also on the basis of unit costs for one ton-kilometer and one net ton-kilometer (exploitation).

The entire own cost for a given type of traffic represents thus the following value:

(1) the value of consumption of material-technical media on the railroads, i.e., permanent media and materials;

(2) the values connected with compensation for labor.

The unit own cost on the other hand is a basic, qualitative factor which characterizes in monetary terms the framework of economic activity by the railroad enterprise in a given production branch (type of traffic).

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It is clear that the smaller the amount of work (live and objectivized) consumed for the creation of a production unit, the larger may be the amount of production created with the same investment; this permits on a national economic scale for a more rapid development of the economy as well as for a material and cultural growth of prosperity, because a decrease in the unit costs basically conditions the lowering of prices. Thus is explained the importance attached to plans for decreasing own costs.

The PKP enterprise bases its annual economic activity in the service branch upon the so-called transportation-financial plan which encompasses a series of branches (sector branches) like the transportation plan, the implementation plan, the plan of rolling stock work, the plan for employment and wages, the equipment plan, the cost plan, etc. The mentioned plan for own costs is on the one hand the result of assumptions in the entire transportation-financial plan, and on the other hand it is a criterion regarding the correctness of these assumptions. Planned tasks for lowering own costs are already included within other branches of the plan but only in the appropriate parts; however in the plan of own costs they are placed in a collective framework. A concrete effect and a synthetic expression for all these tasks are the lowered own costs per unit.

The accounting of own costs utilizes peculiar, and at times very difficult and complex, methods. As far as own planned costs are concerned, the basis of accounting are the numbers included in other parts of the plan; but to compute the resulting own costs the accounting is based upon figures in bookkeeping with reference to the expenditures and upon figures in statistics connected with executing individual parts of the plan.

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Apart from the directing role within the field of implementation control over the plan for own costs, statistics also are a tool in the analysis of implementing this plan, i.e., finding the causes which precipitate deviations in own resulting costs from their corresponding planned costs.

5. Exploiting Internal Reserves to Lower Own Costs

Lowering own costs of units belongs to the basic tasks of the PKP enterprise, since it is one of the factors deciding about the quantity of accumulation. A successful solution to the indicated tasks must be based upon a skillful utilization of data on the possible sources for savings and on the internal reserves of an enterprise.

Internal reserves, which may be utilized for this purpose, can be summarized into the following points:

(a) fulfillment in its entirety, and if at all possible also overfulfillment, of the transportation plan with a simultaneous accurate observance of rational and uniform transportation work;

(b) increasing labor efficiency; a broad application of socialist competition in labor and the methods of shock workers; improvement in the organization of labor together with its mechanization, basing the system of compensation upon premiums paid for fulfilling the plan and for the quality of production, for accelerating turnover of rolling stock units, for savings in the consumption of materials and fuel, etc;

(c) a broad application of average-progressive (for the concept of average-progressive factors, see Y. Yurchenko, Srednyie Progressivnyie Normy na Zheleznodorozhnom Transporte, Moscow, 1950)

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factors for the exploitation of transportation rolling stock and other equipment by introducing improvements in the technological production process which aims to shorten the transportation time, increase the velocity of trains, shorten the turnover-time of freight cars as well as the time for repairs, etc;

(d) increase and improvement in technical equipment of labor, the introduction of new types of locomotives and cars, broadening in the mechanization of labor-consuming work, etc;

(e) increasing the average time of usage for rolling stock, machinery and equipment; decreasing the stoppages and nonproductive labor by locomotives, cars, etc; better utilization of the loading capacity of cars; increasing the weight of trains, etc;

(f) deepening the average-progressive standards for consumption of fuel, materials, spare parts, electric power, use of scraps, etc;

(g) preventing accidents and catastrophes;

(h) decreasing the administrative expenses, a greater rationalization of the system for administration and accounting-reporting work;

(i) exploitating local supplies and substituting them for materials transported from the outside, etc.

To what degree a skillful liberation and exploitation of the above indicated internal reserves may decrease own unit costs, may be proven by the examples below taken from the Soviet work of the author A. Chudova, entitled Planovaya Kalkulatsiya Sebestoimosti Zheleznodorozhnykh Perevozok, Moscow, 1947.

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A change in value of one percent for certain derivative numerical characteristics, describing the exploitation of railroad rolling stock, influences the formulation of the level for own costs per unit in a manner given on Table 14.

6. Control and Analysis of Plan Implementation for Own Costs

The control and analysis over the implementation of the plan for own costs cannot be based upon absolute figures included within total costs; the individual components as well as the sum of these costs are a function of a series of elements and in the course of plan execution may change, e.g., in connection with the overfulfillment of the transportation plan, with a change in the main directions of transportation, etc. Of decisive importance, on the other hand, is the attained level of costs per unit. Thus the plan for lowering own costs is essentially a plan for relative quantities, not absolute ones, and from this point of view control and analysis of plan execution must also be conducted.

Exploitation costs comprise the costs regardless of traffic size, i.e., relatively constant up to a certain limit for the quantity of the traffic, and costs dependent upon the traffic size, i.e., changing in proportion to the quantity of traffic (transportation). The reciprocal relationship of these two types of costs amounts to approximately 42:58. In connection with a traffic increase (loads), the costs independent of traffic are broken down into a larger number of completed units which causes a considerable decrease in own costs per unit.

Thus the first step in control and analysis of plan implementation is the establishment as to whether and to what degree

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the decrease in own costs per unit should be attributed to the mentioned result of traffic increase (transportation).

The next step is to designate the degree to which exploitation costs have been influenced by the implementation of qualitative factors for the utilization of rolling stock, like the average load per one axle of a freight car, the relationship between the run of empty cars and the run of loaded cars, the gross weight of the train, etc. The dependence of own unit costs upon the mentioned qualitative factors is illustrated on Table 14.

TABLE 14

Derivative Numerical Properties, Characterizing the Exploitation of Railroad Rolling Stock	Change in the Own Cost Per Unit in Percentage in Connection with a Change in Value of Derivative Numerical Characteristics by One Percent		
	Type of own cost dependence in passenger or in freight traffic	Change in own cost in freight traffic	Change in own cost in passenger traffic
Average weight of load per one car axle in a dynamic formulation	inversely proportional	0.23	
Percentage of empty freight cars in relationship to the run of empty and loaded cars together	directly proportional	0.20	
Average gross weight of trains in a loaded direction	inversely proportional	0.25	
Percentage of run for locomotives, attached and pushing, to total runs of locomotives	directly proportional	0.20	0.20
Population per one car axle	inversely proportional		0.40
Size of passenger train composition	inversely proportional		0.20

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The local conditions of work may themselves cause deviations from the average relative quantities presented in the table, but these deviations are not large.

A considerable influence upon the change in own costs for transportation is exerted by the change in the standard of consumed labor, material, fuel, and electric power. An analysis as to the size of the influence by the mentioned factors should be conducted separately in relationship to all basic positions for expenditures.

When analyzing the implementation of the plan with regard to the compensation fund, one must consider the degree to which the planned labor efficiency has been implemented; as is known, the efficiency of work for the entire district network is designated in the most general terms by the number of substitute ton-kilometers per one employee during the reporting period. In those districts where the expenditures for the wage fund are endowed with a heavy category weight and increase in labor efficiency considerably influences the own costs for transportation since the quantity of employment remains at an inversely proportional ratio to the labor efficiency. We have already discussed in some detail under statistics of employment and compensation the factors upon which labor efficiency depends.

A larger labor efficiency is justified by and preceded in time by an appropriate increase in the average earned compensation. As a result of this precedence in time, the own costs per unit decrease should labor efficiency increase.

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A much more detailed analysis of plan implementation according to individual positions for expenditures and their components should be conducted by checking upon the execution of the plan by the individual services.

It is specifically necessary to check on the purpose of basic expenditures in these services: mechanical, highway, and traffic as well as to reanalyse the implementation of the consumption norms for labor an materials per unit of the appropriate measurement in these services. The three mentioned services encompass about 81% of all costs on the railroad; this explains the necessity for the special attention being given to the expenditures of these services.

An evaluation of the work done by these services cannot be made exclusively from comparing them with the planned norms for actual expenditures by these services which apply to a unit of this or that measurement. A drop in the expenditures per unit of measurement does not always attest an improvement of the work by a given service; this is illustrated by the following example:

If in a given district administration the expenditures of the traffic service per one freight train-kilometer have decreased by 3% in comparison with the plan and a simultaneous decrease has taken place in the average weight of freight trains by 5% due to the negligence of the traffic service, then even with a 100% plan fulfillment of freight transportation (in ton-kilometers), the results in the work of the traffic service cannot be considered satisfactory; as a result of decreasing the train weight, the run of freight trains has increased by 1 : 0.95 = 1.053 times,

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whereas the expenditures for this service per one ton-kilometer amounted to 97 x 1.053 = 102.1% in comparison with the plan, i.e., an increase of 2.1%.

An analysis of plan implementation for expenditures by railroad units, remaining under the cost accounting system, should be commenced by investigating the reporting calculation of costs for the production of a given unit and comparing it with the planned one. It is necessary in this connection to establish whether the saving or overfulfillment took place in the production costs or else in general costs, the influence exerted by the overfulfillment or underfulfillment of the labor quantity established in the plan, how the standards for labor and materiel consumption as well as the technical norms were executed, and in which positions savings or overfulfillment took place.

Next it is necessary to pass on to the investigation of plan implementation for expenditures according to individual positions.

This analysis, similarly to the analysis of plan implementation by individual services, should be executed according to the individual positions for expenditures and according to their components. In the analysis of standards established by the plan, it is indicated that we compare them with the expenditures per unit of measurements by the outstanding economic units and that we establish the causes taking place for the differences in the expenditures of units being compared.

7. Statistical Compilations

Typical statistical compilations in the area of exploitation expenditures are the tables representing:

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(1) The dynamics of exploitation expenditures over a period of several years:

(a) in absolute figures, i.e., in monetary units;

(b) in factor (indexes) numbers, accepting the total sum for exploitation expenditures (outgo) during the first year of a given multi-year period as 1.00 or as 100.

Statistical compilations of this type will only be above criticism when they encompass years with the same structure for exploitation expenditures.

(2) The formulation of own costs per unit during the individual years of a given time period.

The comments made above on the purpose of making a comparison among exploitation expenditures having the same structure, of course, also refer to the comparative compilations which include own costs per unit over different years (periods).

(3) The structure of exploitation expenditures for a given time period in a category composition and in ultimate comparison with the structure of planned expenditures over a given period.

The quantity of the individual structural components may be expressed in this connection either in monetary units or in numbers designating the percentage participation of exploitation expenditures within the total sum.

E. Financial Results

1. Accumulation, Profitableness, and Gains from Transportation Enterprises

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The accumulation of a production enterprise is called the surplus in the realization of produced commodities or services over the sum of own costs connected with this implementation. In the PKP enterprise, which produces services, accumulation thus represents the surplus of the realization sum over the expenditure total; in this connection we include among the incomes the implementation from transportation, the refunds from major works executed by an economic method, implementation of activity apart from the shop, and the implementation of materials; and to expenditures, general investments, including expenditures for activities apart from the shop as well as the costs for the implementation of materials.

The accumulation from the production of an enterprise covers the turnover tax or the tax on noncommodity operations, whereas the result remaining represents the profit or loss to the enterprise. In such a manner, the profit of the PKP enterprise is the implementation surplus (of incomes) over the total sum for the above indicated expenditures as well as for the tax on noncommodity operations.

The profit level is determined at a level of a designated percent from the margin of own costs for services.

The profit of an enterprise is divided into parts destined for:

(1) the shop fund;

(2) a supplement or increase of own turnover media in an enterprise; this part may not be larger than the total for planned profit, decreased

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(a) by a payment of 10% from the profit as income tax;

(b) by a part of the profit, designated for the shop fund;

(3) payment from profits to the state budget, encompassing the total remaining part of the profit, but not less than 10% of the profit.

With the exception of state enterprises, so-called budget ones, the income and outgo of which are included within the state budget, the remaining state enterprises (also PKP) are conducted according to the principles of economic cost accounting.

The profit of the PKP enterprise is designated in the plan for transportation and finance.

The profitability of an enterprise is expressed in percentages and represents the relationship between the sum of profits and the sum of own costs in an enterprise. If the result of activity is not a profit but a loss, then the enterprise is not profitable.

2. Financial Reporting

Submitting of financial statements, including the total framework of financial results for a given period of activity, is the duty of:

(a) organizational units in PKP enterprises, remaining of a total or limited internal economic cost accounting system; appropriate reports are to be sent each month to the district administration;

(b) district administrations of state railroads; they submit their monthly statements to the Ministry of Railroads, to the appropriate section of the Polish National Bank, as well as to the Ministry of Finance;

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(c) the Ministry of Railroads; it prepares abstract statements and transmits them to the State Economic Planning Commission, to the Main Statistical Office, to the Ministry of Finance, and to the central office of the Polish National Bank.

Monthly financial statements of the district administrations include primarily:

(1) a balance sheet according to an established formula;

(2) an accounting of results;

(3) a statement on the execution of investments and costs;

(4) a statement for the period from the beginning of the year to the end of the reporting period.

Monthly statements in abstract form by the Ministry of Railroads include:

(1) a statement for the period from the beginning of the year to the end of the reporting period;

(2) balance sheets on turnovers and other balances.

The quarterly abstract statements by the Ministry of Railroads encompass primarily:

(1) a balance sheet;

(2) an accounting of results;

(3) implementation of plans for investments and costs;

(4) implementation of the plan for lowering own costs;

(5) implementation of the plan for acceleration of the circulation of turnover media.

The mentioned statements on the implementation of investments and costs include within their introductory part (analytical) data about labor efficiency in its monetary aspect, about the

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relationship between own costs for implementation and the realization totals according to disposal prices, and about the own cost of one work-hour.

As can be seen from the contents of financial statements, these latter permit us to draw conclusions on the course of implementation taken by a financial-economic plan, especially in the fields of:

(a) execution of tasks for lowering own costs and formulation of the wage fund;

(b) implementation of tasks for acceleration in the circulation of turnover media and formulation of the remainder in materials and products (commodities);

(c) implementation of the plan for realization;

(d) planned execution of investments and correctness in their financing;

(e) losses sustained due to deficiencies, stoppages, and waste;

(f) implementation of profitability plan;

(g) accounting with the budget from the point of view of correctness and urgency.

3. Statistical Compilations

Among the more important quantities, characterizing the financial results of PKP enterprises, we should include the previously discussed profitability as well as the so-called coefficient of exploitation; the latter is computed by dividing the sum of exploitation costs for a given period (usually annual) by the sum of incomes.

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When the size of the coefficient amounts to 1, the exploitation costs are equal to the income; as the surplus of costs over incomes goes up, the size of the coefficient becomes correspondingly higher than the unit (1); when there is a surplus of incomes, however, the size of the coefficient falls below the figure one (1).

The quantity of this coefficient is frequently expressed by a percentage figure according to the formula:

$$\text{exploitation coefficient} = \frac{\text{sum of costs x 100}}{\text{sum of incomes}} .$$

Until recently the PKP could compute the size of this coefficient only for the entire network with an ultimate division into regular and narrow gauge lines; the establishment of a quantity for the exploitation coefficient in the individual district administrations became possible only when the incomes due them were separated.

The coefficient of exploitation is not an accurate factor for the description of financial results in enterprises, insofar as we also consider indirectly through the quantity of income the level of tariff rates which is dependent to a minimum degree upon the enterprise itself.

An improvement or worsening of results for designated exploitation coefficients is pictured on tables compiled over a period of many years. Under conditions of a socialist planned economy, such tables illustrate the appropriate picture of things only in the event that they are

(1) compared with the appropriate planned quantities;

(2) include, during the individual years of a given period, the expenditures for exploitation having the same structure;

(3) pertain to years with similar general-economic conditions.

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